COLORADO GEOLOGICAL SURVEY

Open-File Report OF-25-06

Technical Memorandum

Baseline Radiological Study Year 4: Lower Arkansas River Area, Colorado

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ABOUT THIS REPORT

Funded through a grant from the Colorado Department of Public Health & Environment (CDPHE) the CGS is conducting a five-year baseline study of naturally occurring radionuclides and metals in groundwater samples obtained from privately owned residential water wells throughout Colorado. This report presents the methodology and available results from the fourth year of the study (2025) that focused on the Lower Arkansas River Area of southeast Colorado, specifically including portions of Pueblo, Crowley, Otero, Kiowa, Bent, and Prowers counties.

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RE: Baseline Groundwater Study Year 4 Report, Lower Arkansas River Area, Contract 2025*1921

The Colorado Geological Survey (CGS), a department of the Colorado School of Mines, has been funded through a grant from the Colorado Department of Public Health and Environment (CDPHE) to conduct a 5-year study of baseline naturally occurring radionuclides and metals in groundwater obtained from privately owned residential water wells throughout Colorado. This report presents the methodology and results of Year 4 conducted in 2025, in the Lower Arkansas River area, located in southeastern Colorado. The study area included parts of Pueblo, Crowley, Otero, Kiowa, Bent, and Prowers counties, along with a few adjacent samples from Huerfano and Custer counties.

Purpose: Per CDPHE, the primary purpose is as follows: "Ambient monitoring of groundwater will give scientists and the people of Colorado an idea of background conditions of radionuclides and metals in groundwater in Colorado. This information will help decision makers make informed decisions regarding the care and use of groundwater in these regions of the state. This project will help the state build a baseline water quality dataset for groundwater." CDPHE also stated that the study was to be education focused for homeowners on wells.

Background: The geology of the study area is composed of surficial Quaternary alluvial deposits that infill the Lower Arkansas River valley, overlying a bedrock sequence of Upper Cretaceous marine sediments. These marine units, deposited between about 100 and 76 million years ago (within the Western Interior Seaway), consist primarily of shale, limestone, and sandstone. Near surface bedrock units consist of predominantly younger Cretaceous formations on the northern side of the valley compared to the south. Mapped units include Late Cretaceous formations (Pierre Shale, Fort Hays Limestone Member of the Niobrara Formation, and Carlile Shale of the Benton Group) and the early Late Cretaceous formation (Dakota Sandstone). The Dakota Sandstone is present almost exclusively on the southern side (**Figure 1**). Cretaceous marine shales, including several of those present in the Lower Arkansas Valley, are recognized sources of naturally occurring uranium throughout the western United States (Barkmann and others, 2022[1]; Bern and Stogner, 2017[2]).

Beyond lithological variability, land use practices also play a significant role. Agricultural irrigation activities are primarily concentrated near the Arkansas River and its tributaries, which can enhance the mobilization of naturally

[1] Barkmann, Peter E., Martin J. Palkovic, Lesley A. Sebol, Lauren D. Broes, Kenneth Swift Bird, Timothy K. Gates, Ryan T. Bailey, John T. Cox, Erin N. Underwood, and Kenan Diker. 2022. Natural Sources of Mobile Uranium in the Downstream Reach of Colorado's Arkansas River Valley and Evaluation of Best Management Practices for Mitigation. Hydrogeologic. Open File Report. Golden, CO: Colorado Geological Survey, January 2022. https://doi.org/10.58783/cgs.of1911.wgkr1130. CGS Publications.
[2] Bern, Carleton R., and Robert W. Stogner Sr. 2017. The Niobrara Formation as a challenge to water quality in the Arkansas River, Colorado, USA. Journal of Hydrology: Regional Studies 12: 181-195.

occurring uranium in oxic waters. Irrigation can contribute to oxidizing conditions, which result in a mobilized uranium that remains mobilized (Barkmann and others, 2022[1]; Zielinski and others, 1995[3]). In semi-arid regions (such as the study area), where the Cretaceous marine formations underlie irrigated areas, elevated concentrations of dissolved uranium in both surface and subsurface waters have been documented (Qurban and others, 2025[4]). Notably, uranium and radium demonstrate an inverse mobility regulated by redox conditions, wherein oxidizing environments facilitate uranium dissolution while anoxic conditions allow for radium mobility (Felmlee and Cadigan, 1979[5]; Faraja and others, 2020[6]).

Data from the National Uranium Resource Evaluation (NURE[7]) highlight consistently elevated uranium concentrations along the Arkansas River Valley, particularly downstream of Pueblo and increasing eastward, beyond the John Martin Reservoir. Spatial analysis reveals that the uranium concentrations are frequently higher on the northern side of the valley compared to the southern side (**Figure 2**). This difference may reflect variations in underlying stratigraphy as well as the extent of irrigation activity and recharge dynamics across the valley.

2025 Methodology

To obtain representative coverage with a focus on areas with elevated uranium levels, the study area was divided into grids based on existing 1:24,000-scale (quadrangle) geologic map boundaries. Grid creation was refined using the constructed residential wells data from the Colorado Division of Water Resources (DWR) for the main six counties in the study area, downloaded on May 14, 2025. In areas where few residential wells were present, resulting in a low likelihood of volunteer participation, multiple geologic quadrangle areas were combined to form larger grid spaces. This process resulted in an initial set of 35 grid areas. Two additional grids were later added, and a few were edited to accommodate better volunteer participation, bringing the total to 37 grids **(Figure 3).**

Volunteer-Based Method: The sampling approach was to solicit volunteers who use privately owned residential wells as their water supply. While the initial focus was on drinking water wells, it was later expanded to include all types of actively used residential private water wells to allow for greater participation. The CGS sent sampling kits to volunteers, who collected groundwater samples and shipped them back using a prepaid shipping label. Upon receipt, samples were assigned anonymized identification numbers and stored until enough were collected to ship to the analytical laboratory, typically in batches of six or 12 samples (in one or two coolers). Sample identification numbers were generated using the following format: the year (2025) first, followed by the Federal Information Processing System (FIPS) code for the county, then the Colorado state FIPS code (08), and finally a sequential sample number. The county FIPS codes for the counties included in the study area were Kiowa (061), Otero (089), Bent (011), Crowley (025), Prowers (099), Pueblo (101), Huerfano (55), and Custer (27).

Sampling: The CGS sampling kits included a 9x9x9-inch cardboard box lined with a plastic bag, a laboratory-supplied 1-gallon (4-liter) sample container pre-preserved with 24 ml of 1:1 nitric acid, and a Ziploc bag containing a pair of nitrile gloves, sampling instructions, a sampling form for the well owner to complete, tape for resealing the box, and a prepaid FedEx return shipping label.

[3] Zielinski, Robert A., Sigrid Asher-Bolinder, and A. L. Meier. 1995. Uraniferous waters of the Arkansas River valley, Colorado, USA: a function of geology and land use. Applied geochemistry 10: 133-144.
[4] Qurban, I. A., Gates, T. K., Morway, E. D., Cox, J. T., White, J. T., Bailey, R. T., and Fienen, M. N. 2025. Assessing nonpoint-source uranium pollution in an irrigated stream-aquifer system. Science of The Total Environment, 989, 179861.
[5] Felmlee, J. Karen, and Robert A. Cadigan. 1979. Radium and uranium concentrations and associated hydrogeochemistry in ground water in southwestern Pueblo County, Colorado. USGS Open-File Report 79-974.
[6] Faraj, Turki, Azza Ragab, and Mohamed El Alfy. 2020. Geochemical and hydrogeological factors influencing high levels of radium contamination in groundwater in arid regions. Environmental Research 184: 109303.
[7] The National Uranium Resource Evaluation (NURE) program's Hydrogeochemical and Stream Sediment Reconnaissance (HSSR) phase (1976-1984) which systematically survey the U.S. for potential uranium resources using geochemical analyses of water samples across the country. USGS Open-File Report 97-492.

Well owners were asked to collect the groundwater sample by running their water long enough to obtain fresh water directly from the well, rather than water that may have been sitting in household piping or water tanks. If a filtration system was present, they were asked to bypass it to collect untreated ("raw") water. After sample collection, the water container was placed inside the plastic bag (to prevent leaks), the sampling form was completed and sealed inside the Ziploc bag, and the box was repackaged. Participants then either dropped off the package at a local FedEx office or drop box or arranged a FedEx pickup, either independently or through the CGS.

The sample form included the well owner's contact information, sampling date and time, and, optionally, well details such as the DWR permit number, well depth, whether the well was completed in overburden or bedrock, and any filtration system that was or was not bypassed.

Sample Handling and Laboratory Analysis: Eurofins St. Louis, located in Earth City, MO, was contracted by the CDPHE to perform laboratory analysis in 2025. Following standard chain-of-custody procedures, the CGS dropped off the samples at the local Eurofins laboratory in Denver. From there, the samples were shipped overnight to the Eurofins laboratory in St. Louis. Upon arrival, the St. Louis laboratory logged the samples and assigned a unique laboratory ID number to each one.

The list of analytes tested in this year's study remained consistent with those analyzed in the last two years. These included:

- **Metals**: aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, selenium, silver, thallium, thorium, tin, uranium, vanadium, and zinc
- **Radiological parameters**: gross alpha and gross beta activity
- **Isotopes**: radium-226, radium-228, thorium-228, thorium-230, and thorium-232.

Laboratory turnaround time was typically one month from the date of shipment. The CGS sent individual laboratory results by email to the well owners along with a copy of a CDPHE Fact Sheet. The Fact Sheet lists the analytes tested in the study, their health-based guidelines, and potential health impacts. It also provides recommendations for water treatment filter options when results exceed guideline levels, as well as contact information for the CDPHE Toxicology and Environmental Epidemiology Office (Toxcall).

Volunteer Solicitation: This year, the solicitation of private well owners to volunteer for the study focused on four primary methods: (1) placing newspaper ads, (2) reaching out to relevant local organizations, (3) collaborating with the CDPHE PFAS Study Group, and (4) a postcard campaign.

(1) Newspaper advertisements

Printed and digital newspaper ads were placed in local newspapers for four weeks, beginning on June 4, 2025. The newspapers included were the Prowers Journal, Kiowa County Independent, Bent County Democrat, and La Junta Tribune-Democrat. Additionally, a story about the study was published in the Kiowa County Independent on June 20, 2025. A separate four-week ad campaign began on July 24th in the Pueblo Chieftain newspaper. The ad included basic information about the funded study along with a grid map of the study area. Private well owners were invited to participate and receive a free water test. Interested volunteers were asked to email the CGS with their address, phone number, and DWR well permit number (if known).

(2) Reaching out to local organizations

The CGS emailed a flyer to various organizations, requesting their assistance in promoting the study to local communities. They were encouraged to share the information through their websites, Facebook pages, or any other communication channels they found effective. The flyer was provided to county governments, local public health departments, Colorado State University Extension offices, city administrations, libraries, conservation districts, Division 2 of the DWR, and the Lower Arkansas Valley Water Conservancy District. Outreach efforts also featured posts on the CGS Facebook and Instagram pages. Additionally, the CGS presented the study at the July meeting of the Arkansas Basin Roundtable, where the flyer was distributed to participants who were asked to share it within their respective organizations.

(3) Collaborating with the CDPHE PFAS Study Group

A CDPHE study group focused on PFAS in private wells agreed to include a note about the CGS study in their outreach efforts. As a result, the CGS received email addresses of potential volunteers from the PFAS group, most located within Pueblo County. Of those, seven agreed to participate in the CGS study.

The response to all advertising methods was lower than expected, and by the end of August, after about three months of efforts, only 38 well owners had volunteered to participate (about a quarter of the target number). To boost participation and to provide adequate coverage of the study area, the CGS decided to launch a one-time postcard campaign.

(4) Postcard campaign

There are about 5,280 residential water wells constructed within the study area, many of which are in rural areas where standard USPS mail is not always deliverable. To address this, the CGS sent out 3,206 postcards to residential households along 17 USPS routes using Every Door Direct Mail (EDDM) service. The EDDM method ensures that every residential mailbox along a selected route receives a postcard, with no specific addresses or recipient names required. The postcard text was similar to that of the newspaper ads and flyers, excluding the grid map. It included a CGS email address and phone number and a QR code directing recipients to a digital volunteer sign-up form.

As a result of the postcard campaign, CGS received responses from 84 potential volunteers: 14 via voicemails, eight by email, and 62 through the digital sign-up form, representing a response rate of about 2.6%.

Sample tracking: The CGS reviewed each incoming volunteer and used the ArcGIS Pro *Locate* tool to identify the location of wells using their addresses within the study grid map. Then the CGS responded by email with detailed information about the study, including background information, lists of the tested radionuclides and metals, and a request for confirmation of participation.

Tracking of volunteer participation and sample status was managed using both a spreadsheet and an ArcGIS Pro feature class. The feature class enabled tracking the spatial distribution of samples to ensure they were within the study area and not overly clustered. Five of the confirmed well owners never sent back their water samples even though they received reminders.

On the well sampling form, most volunteers were able to provide at least partial well information, with well depth being the most commonly completed field. For wells lacking a DWR permit number, the DWR database was queried to obtain well details. Provided well depths were verified and, if they differed from DWR records, adjusted in the project data tables. Where available, the geologic formation listed in the driller's well log was also obtained or confirmed. Additional geologic information was sourced from the subcrop geologic map and stratigraphic column presented in Barkmann and others (2022), the Colorado Statewide Alluvial Aquifer Map (Lindsey and others, 2021[8]), along with interpretations based on surface geology and wells' lithology.

2025 groundwater samples and laboratory results

A total of 91 groundwater samples were collected from private wells in the Lower Arkansas River area between June and November 2025. The wells ranged in depth from 22 to 800 feet (ft). Most of the shallower wells (to about 100 ft) are completed in the alluvial aquifer, while the deeper wells are mainly completed in the Dakota Sandstone aquifer. **Figure 4** shows the spatial distribution of sampled wells across the study grid areas. **Table 1** summarizes all sampled wells, including their CGS-assigned sample number, laboratory-assigned ID number, location coordinates (rounded to two decimal places, about a 1.1 km radius), well depth, geologic information, and water quality data. Results that exceed applicable drinking water guidelines are shown in bold in Table 1.

[8] Lindsey, Kassandra O., Peter E. Barkmann, and Lesley A. Sebol. 2021. ON-010-02D Colorado Statewide Alluvial Aquifer (Data). Aquifers, Variable. Golden, CO: Colorado Geological Survey, March 4, 2021. https://coloradogeologicalsurvey.org/publications/colorado-alluvial-aquifer-data/.

Spatial distribution of groundwater quality data for specific metals and radionuclides that exhibited exceedances of their applicable drinking water guidelines is presented in **Figures 5 through 21**. Also included are radionuclides that either have no drinking water guideline or did not exceed guidelines but contribute to gross radionuclide measurements (like thorium). Figures were generated for the following analytes: uranium (Figure 5), thorium (Figure 6), gross alpha (Figure 7), gross beta (Figure 8), radium-226 plus radium-228 (Figure 9), thorium-230 plus thorium-232 (Figure 10), thorium-228 (Figure 11), arsenic (Figure 12), boron, (Figure 13), cadmium (Figure 14), cobalt (Figure 15), iron (Figure 16), lead (Figure 17), manganese (Figure 18), molybdenum (Figure 19), selenium (Figure 20), and zinc (Figure 21). In these figures, sample locations with no detections of the analyte of interest are shown as small, light gray circles. Concentrations at or below the drinking water guideline (including detected estimated values below the reporting limit) are shown in blue, with guideline exceedances being shown in red. No figures were generated for non-radioactive metals having no exceedances of their respective water quality guidelines.

Data Evaluation

Analytes exhibiting exceedances of the applicable drinking water guidelines from most to least include (with the number of exceedances): gross alpha (56), radium-226+228 (29), uranium (23), selenium (13), manganese (8), lead (7), gross beta (4), cobalt (3), iron (3), molybdenum (3), boron (2), arsenic (1), cadmium (1), and zinc (1). The following bullet list presents observations for the various analytes:

- Uranium was detected at 53 of the 91 sampled wells at concentrations above the reporting limit (0.001 mg/L) and at 11 additional wells with estimated values below the reporting limit. Twenty-three exceedances of the applicable drinking water guideline (0.03 mg/L) were noted (Figure 5). Uranium exceedances were found at shallower well depths (22 to 124 ft) mainly within the alluvial aquifer or in alluvial wells that straddle into a few feet of bedrock, most of which are within agricultural areas (Figure 5). The spatial distribution of the uranium exceedances is generally within a two-mile distance of the Arkansas River and its tributaries, with 11 of the wells located on the northern side of the river and 12 on the southern side. Of the 64 wells with uranium detections, 25 are within the unconsolidated aquifer, 12 are in wells that straddle into bedrock, and 21 are within bedrock (the remaining six are of unknown depth or geology). These uranium occurrences are likely driven by oxidizing conditions within the unconsolidated aquifer, which enhances uranium mobility.
- Thorium was detected at concentrations equal to or above the reporting limit (0.002 mg/L) at two wells, one in Pueblo County (unknown depth) and the other in Otero County (30 ft depth), and at six more wells with estimated values below the reporting limit (Figure 6).
- Gross Alpha was detected at 71 wells (Figure 7) with 56 of those exceeding the guideline (15 pCi/L). More information is provided in the section "Gross Alpha discussion" below.
- Gross Beta was detected at 80 wells with only four exceedances above the guideline (50 pCi/L), all within Pueblo County (Figure 8).
- Radium-226 and radium-228 were individually detected at 53 and 65 wells, respectively. Both were detected at 49 of these wells. Twenty-nine wells exhibited exceedances of the combined Radium-226+228 guideline of 5 pCi/L (Figure 9). These exceedances occur in deeper wells (137 to 660 ft), mostly within the Dakota Sandstone aquifer, of which about one third are also screened into the overlying Graneros Shale. All the exceedances are located south of the Arkansas River. Of the 69 wells where radium-226, radium-228, or both were detected, 41 are from wells within bedrock, seven more are in wells that straddle into bedrock, and only 14 are within the unconsolidated aquifer (the remaining seven are of unknown depth or geology). This may be due to anoxic conditions in the deeper confined bedrock units which facilitate radium mobility.
- Both thorium-230 and thorium-232 were detected at one well in Pueblo County (depth and geology unknown), where thorium was also detected above the reporting limit (Figure 10). Thorium-228 has no drinking water guideline but was detected at 15 wells (Figure 11). Of these, 14 are in Pueblo County and

one in Bent County, specifically at wells where radium-226+228 exceedances were also detected. These are deeper wells (225 to 660 ft) within the Dakota Sandstone aquifer, of which about one third are also screened into the overlying Graneros Shale.

- Arsenic was detected at a concentration above the reporting limit (0.01 mg/L), which also exceeded the guideline (0.01 mg/L) at a single well in Pueblo County (unknown depth and geology). It was detected at estimated concentrations below or at the reporting limit at 16 additional wells (Figure 12).
- Boron was detected at a concentration above the reporting limit (mostly 0.1 mg/L) at 58 wells, with two exceedances above the guideline (1.4 mg/L) in Crowley County at well depths of 22 and 34 ft (geology unknown, possibly Quaternary). Boron was also detected at estimated concentrations below the reporting limit at 34 wells (Figure 13).
- Cadmium was detected at a concentration equal to or above the reporting limit (0.0005 mg/L) at two wells, of which one exceeded the guideline (0.005 mg/L) in Crowley County at a well depth of 40 ft, possibly within the Pierre Shale. Cadmium was estimated below the reporting limit in an additional six wells (Figure 14).
- Cobalt was detected at a concentration equal to or above the reporting limit (0.002 mg/L) at eight wells with three exceeding the guideline (0.006 mg/L), two in Pueblo County within the Graneros Shale and the Dakota Sandstone aquifer and one in Otero County in a shallow alluvial well. Cobalt was estimated below the reporting limit in 13 more wells (Figure 15).
- Iron was detected at a concentration above the reporting limit (0.005 mg/L) at 67 wells of which three exceeded the guideline (14 mg/L). One was in Pueblo County (depth unknown) and the other two were in Bent County (one deep well within the Dakota Sandstone and the other of unknown depth). Iron was also estimated below the reporting limit at 14 wells (Figure 16).
- Lead was detected at estimated concentrations below the reporting limit (0.003 mg/L) at 29 wells and was present above the reporting limit at seven more wells, which are considered exceedances. The wells are of different depths and lithologies (Figure 17).
- Manganese was detected at a concentration above the reporting limit (0.005 mg/L) at 62 wells, and at estimated concentrations at 14 wells (Figure 18). Eight wells with different depths and lithologies had exceedances above the guideline (0.3 mg/L).
- Molybdenum was detected at a concentration above the reporting limit (0.005 mg/L) at 48 wells, of which three wells had exceedances above the guideline (0.035 mg/L): one in Pueblo County within the Dakota Sandstone, one in Kiowa County in a shallow Quaternary well, and the other in Prowers County in the Alluvial aquifer straddling into the Carlile Shale. Molybdenum was estimated below the reporting limit at 33 more wells (Figure 19).
- Selenium was detected at a concentration above the reporting limit (0.005 mg/L) at 42 wells, 13 of which had exceedances above the guideline (0.05 mg/L) across six counties with different depths and lithologies. It was also estimated below the reporting limit at seven more wells (Figure 20).
- Zinc was detected at a concentration above the reporting limit (0.02 mg/L) at 55 wells, with only one exceedance above the guideline (2 mg/L) in Pueblo County at a well with unknown depth or geology. It was also estimated below the reporting limit at 24 more wells (Figure 21).

Gross Alpha discussion

For many of the gross alpha (GA) samples analyzed by EPA Method 900.0, the laboratory flagged the data with a "G" qualifier noting: "The detection goal was not met due to a reduction of the sample size attributed to high residual mass. Analytical results are reported with the detection limit achieved". High residual mass means that there were high levels of dissolved solids in the water samples. Reduction of the sample size indicates that it had to be diluted. As a result, although the laboratory default Reporting Limit (RL) for GA is 3 pCi/L, the Minimum Detectable Concentration (MDC) was higher than 3 pCi/L for most samples. Furthermore, the analytical precision was relatively poor for these diluted samples, with the percentage total uncertainty (calculated as the total uncertainty divided by the result concentration, multiplied by 100) ranging broadly from 19% to 69%.

To ensure data validity, samples with a MDC greater than the 15 pCi/L drinking water guideline were selected for re-analysis using the Standard Method SM7110C. This alternative method is better designed to handle samples containing high dissolved solids than the original EPA Method 900.0.

Re-analysis results and data validation: Of the 91 GA samples, 24 were sent for re-analysis by SM7110C (about 25%). Results of both analytical methods are summarized in **Table 2** and presented in **Figure 22.** While most samples that initially exceeded the 15 pCi/L guideline using EPA Method 900.0 were confirmed to still exceed the guideline, the re-analysis typically reported lower concentrations and demonstrated higher precision. Importantly, three samples initially flagged as non-detected ("U" qualifier) were found to have measurable GA; two were below the guideline, while one was detected at a concentration above the guideline, confirming an exceedance. All samples showed higher precision overall, with percentage total uncertainty ranging from 12.6% to 31.4% (compared with the 19% to 69% from the EPA Method 900.0 analysis).

Gross Alpha exceedance and radioactivity contributors: Ultimately, when combining both analysis methods, GA was detected above the drinking water guidelines in 57 wells out of the 91 sampled, representing 63% of the total. The GA radioactivity is primarily contributed by uranium, radium-226, and thorium. Out of the 57 wells exceeding the GA guideline, 37 wells had uranium above the reporting limit (0.001 mg/L) of which 23 exhibited exceedances (above 0.03 mg/L). Similarly, 32 wells had radium-226 present, at one of them thorium, thorium-228, -230, and -232 were also present, and at 12 more thorium-228 was present. Notably, there were no wells among the exceeding GA subset that completely lacked uranium, radium-226+228, or thorium-228+230+232 above their respective reporting or detection limits.

A distinction was observed in the GA contributors: the uranium exceedances were found at shallower wells mainly within the alluvial aquifer or in alluvial wells that straddle into a few feet of bedrock, most of which are within agricultural areas. Conversely, the radium-226+228 exceedances were found in deeper wells predominantly within the Dakota Sandstone aquifer, of which about one third are also screened into the overlying Graneros Shale. As a result of these radioactive contributions, GA radioactivity was found to be significant across the Lower Arkansas River study area, with exceedances of the drinking water guideline in 63% of the sampled wells. This high frequency underscores the importance of testing individual radionuclides to account for contributions across different geological formations, providing a more accurate characterization of the groundwater quality.

Best Regards,

Orna Buch Leviatan
Geologist III

&

Lesley Sebol, PhD
Senior Hydrogeologist, Groundwater Program Manager

Attachments:

Table 1. Water quality data in the Lower Arkansas River area, Colorado
Table 2. Gross Alpha concentrations in the Lower Arkansas River area, Colorado. EPA Method 900.0 and SM7110C method.

Figure 1. Simplified geologic map of the Lower Arkansas River area, Colorado at 1:500,000 scale (modified from Tweto, 1979).
Figure 2. National Uranium Resource Evaluation (NURE) groundwater data in the Lower Arkansas River area, Colorado.
Figure 3. Constructed residential wells from the Colorado Division of Water Resources (DWR) and the 37 Study Grids.
Figure 4. Residential water wells sampled in 2025 in the Lower Arkansas River area, Colorado.
Figure 5. Uranium concentrations in milligrams per liter (mg/L) from water wells in the Lower Arkansas River area, Colorado.
Figure 6. Thorium concentrations in milligrams per liter (mg/L) from water wells in the Lower Arkansas River area, Colorado.
Figure 7. Gross Alpha concentrations in picocuries per liter (pCi/L) from water wells in the Lower Arkansas River area, Colorado.
Figure 8. Gross Beta concentrations in picocuries per liter (pCi/L) from water wells in the Lower Arkansas River area, Colorado.
Figure 9. Radium-226+228 concentrations in picocuries per liter (pCi/L) from water wells in the Lower Arkansas River area, Colorado.
Figure 10. Thorium-230+232 concentrations in picocuries per liter (pCi/L) from water wells in the Lower Arkansas River area, Colorado.
Figure 11. Thorium-228 concentrations in picocuries per liter (pCi/L) from water wells in the Lower Arkansas River area, Colorado.
Figure 12. Arsenic concentrations in milligrams per liter (mg/L) from water wells in the Lower Arkansas River area, Colorado.
Figure 13. Boron concentrations in milligrams per liter (mg/L) from water wells in the Lower Arkansas River area, Colorado.
Figure 14. Cadmium concentrations in milligrams per liter (mg/L) from water wells in the Lower Arkansas River area, Colorado.
Figure 15. Cobalt concentrations in milligrams per liter (mg/L) from water wells in the Lower Arkansas River area, Colorado.
Figure 16. Iron concentrations in milligrams per liter (mg/L) from water wells in the Lower Arkansas River area, Colorado.
Figure 17. Lead concentrations in milligrams per liter (mg/L) from water wells in the Lower Arkansas River area, Colorado.
Figure 18. Manganese concentrations in milligrams per liter (mg/L) from water wells in the Lower Arkansas River area, Colorado.
Figure 19. Molybdenum concentrations in milligrams per liter (mg/L) from water wells in the Lower Arkansas River area, Colorado.
Figure 20. Selenium concentrations in milligrams per liter (mg/L) from water wells in the Lower Arkansas River area, Colorado.
Figure 21. Zinc concentrations in milligrams per liter (mg/L) from water wells in the Lower Arkansas River area, Colorado.
Figure 22. Comparative Gross Alpha concentrations in picocuries per liter (pCi/L) from water wells in the Lower Arkansas River area, Colorado. EPA Method 900.0 and Standard Method SM7110C.

Sample ID	Lab ID	Latitude	Longitude	Sample Date	Time	Well Depth	Geology[2]/Units	Gross Alpha			Gross Beta			Radium-226			Radium-228			Ra-226+228	Thorium-228			Thorium-230			Thorium-232			Th-230+232
							DWG[1]:	15			50			--->			--->			5	--->			--->			--->			60
								(pica/L)	Q	2σ(±)[3]	(pica/L)	Q	2σ(±)[3]	(pica/L)	Q	2σ(±)[3]	(pica/L)	Q	2σ(±)[3]	(pica/L)	(pica/L)	Q	2σ(±)[3]	(pica/L)	Q	2σ(±)[3]	(pica/L)	Q	2σ(±)[3]	(pica/L)
20250890801	160-58685-1	38.01	-103.67	6/13/2025	13:30	30	Unk (Alluvium?)	**101**	G	27.3	6.93	G	6.86	0.880		0.409	0.00936	U	0.434	0.88	0.189	U	0.316	0.126	U	0.310	-0.0339	U	0.0469	ND
20250990802	160-58685-2	38.10	-102.47	6/15/2025	8:58	620	Cheyenne Ss and green Sh	**16.5**	G	4.99	9.63		2.28	4.16		0.773	1.64		0.579	**5.8**	0.0353	U	0.164	-0.013	U	0.177	-0.0333	U	0.0303	ND
20250110803	160-58685-3	38.09	-103.20	6/19/2025	14:35	61	Gravel and Sh (Alluvium and Benton Group?)	**99.6**	G	24.6	17.2	G	7.38	0.144	U	0.176	-0.0396	U	0.282	ND	0.0934	U	0.154	0.0913	U	0.195	-0.0135	U	0.0244	ND
20250890804	160-58685-4	37.97	-103.58	6/20/2025	11:03	570	Possibly Dakota Ss?	**34.0**	G	10.8	26.0	G	5.11	9.58		1.26	14.7		1.77	**24.28**	0.219	U	0.219	0.115	U	0.213	-0.0231	U	0.0288	ND
20250990805	160-58685-5	38.10	-102.65	6/17/2025	11:00	40?	Unk (Alluvium?)	**26.0**	G	12.2	5.82	U G	4.74	0.114	U	0.170	0.283	U	0.349	ND	-0.00089	U	0.159	-0.0741	U	0.159	-0.00416	U	0.0529	ND
20250110806	160-58685-6	38.06	-103.27	6/15/2025	19:40	Unk	Unk	**38.6**	G	15.1	12.9	G	5.62	-0.0141	U	0.171	0.508	U	0.411	ND	0.0142	U	0.155	0.0245	U	0.185	0.00800	U	0.0499	ND
20250990807	160-58925-1	38.02	-102.25	7/1/2025	11:00	485	Ss and Sh (Dakota Ss)	13.6	G	6.26	11.6	G	3.65	1.29		0.400	3.59		0.804	4.88	-0.000258	U	0.150	0.146	U	0.206	0.0413	U	0.0769	ND
20250610808	160-58925-2	38.29	-102.50	7/8/2025	7:00	23	Sand, clay and gravel (Alluvium)	**34.2**	G	13.3	8.97	G	5.18	0.107	U	0.196	0.632		0.377	0.632	-0.0272	U	0.152	0.0162	U	0.19	0.00906	U	0.0534	ND
20250990809	160-58925-3	38.07	-102.61	7/9/2025	6:45	110?	Dakota Ss?	**50.0**	G	23.6	15.3	U G	12.2	0.0474	U	0.134	0.560	U	0.396	ND	-0.0214	U	0.162	-0.00795	U	0.172	-0.0338	U	0.0307	ND
20250990810	160-58925-4	38.16	-102.11	6/28/2025	7:25	73	Sand, clay and Sh (Alluvium?)	**37.1**	G	12.7	10.2	G	5.34	-0.0241	U	0.211	0.0269	U	0.278	ND	0.0255	U	0.177	-0.0737	U	0.170	-0.00984	U	0.0241	ND
20250610811	160-58925-5	38.32	-102.86	7/9/2025	19:00	50	Sand, clay, Sh (Quaternary and Smoky Hill Sh)	**31.1**	G	13.0	14.8	G	5.74	0.0163	U	0.160	0.0944	U	0.254	ND	-0.106	U	0.116	0.0877	U	0.202	-0.0140	U	0.0255	ND
20251010812	160-58925-6	38.26	-104.51	7/15/2025	18:05	27	Gravel and Sh (Quaternary and Pierre Sh?)	**28.8**	G	15.9	-1.2	U G	8.43	-0.0193	U	0.190	0.341	U	0.326	ND	0.0275	U	0.175	0.0115	U	0.194	0.0109	U	0.0596	ND
20251010813	160-59052-1	38.34	-104.60	7/18/2025	11:25	60	Gravel, clay and Sh (Alluvium and Pierre Sh?)	10.4	G	6.68	4.24		2.13	0.215	U	0.210	0.909		0.478	0.909	0.0167	U	0.169	-0.0369	U	0.181	-0.0413	U	0.0344	ND
20250990814	160-59052-2	38.10	-102.63	7/18/2025	7:30	30	Sand and gravel (Alluvium)	**51.2**	G	22.8	9.26	G	6.20	0.0725	U	0.206	0.767		0.417	0.767	-0.0446	U	0.123	0.0434	U	0.185	-0.0173	U	0.0255	ND
20251010815	160-59052-3	38.05	-104.81	7/21/2025	8:20	165?	Ss and Sh (Graneros Sh)?	**18.0**	G	6.64	4.62		2.40	0.696		0.319	0.554		0.374	1.25	-0.216	U	0.104	-0.0211	U	0.184	-0.00990	U	0.0243	ND
20250990816	160-59052-4	38.09	-102.62	7/19/2025	13:50	22	Alluvium	**39.5**	G	21.3	4.81	U G	5.55	0.106	U	0.205	0.223	U	0.338	ND	-0.0265	U	0.155	-0.0182	U	0.181	0.0379	U	0.0722	ND
20251010817	160-59052-5	38.10	-104.73	7/23/2025	7:50	442	Ss and Sh (Dakota Ss?)	**33.4**	G	7.05	33.0		4.25	9.40		1.27	27.8		3.11	**37.2**	0.240	U	0.207	0.0666	U	0.198	0.00445	U	0.0530	ND
20250890818	160-59052-6	38.10	-103.75	7/15/2025	12:30	26-30	Alluvium	9.38	U G	6.50	3.61		2.12	-0.0769	U	0.133	0.506	U	0.377	ND	-0.0165	U	0.134	0.0363	U	0.191	0.0181	U	0.0526	ND
20251010819	160-59163-2	38.18	-104.78	7/21/2025	12:45	Unk	Unk	**68.5**	G	18.7	**87.7**	G	13.4	24.2		3.03	73.0	G	7.78	**97.2**	4.53		1.04	0.720		0.455	0.362		0.264	1.082
20250110820	160-59163-3	38.07	-103.36	8/4/2025	9:30	431	Ss (Dakota Ss)	5.53	U G	8.72	2.33	U G	2.93	0.440		0.266	0.590	U	0.446	0.44	-0.105	U	0.260	0.108	U	0.294	0.102	U	0.159	ND
20250110821	160-59163-4	38.07	-103.36	8/4/2025	9:15	24	Unk (Alluvium?)	**81.8**	G	23.8	4.82	U G	6.18	-0.0488	U	0.140	0.858		0.464	0.858	-0.0292	U	0.142	0.0334	U	0.185	-0.00962	U	0.0234	ND
20250990822	160-59321-1	38.13	-102.50	8/10/2025	18:20	93?	Unk	0.351	U G	2.75	10.7		2.44	0.368		0.209	1.11		0.482	1.478	-0.0367	U	0.122	0.0513	U	0.184	0.00101	U	0.0674	ND
20250990823	160-59321-2	38.14	-102.16	8/12/2025	5:45	179	Sand and clay (Quaternary)	**28.6**	G	10.5	6.35	G	3.02	0.237	U	0.184	0.551	U	0.402	ND	-0.0238	U	0.0938	-0.00260	U	0.173	0.0161	U	0.0486	ND
20250990824	160-59321-3	38.08	-102.66	8/11/2025	17:00	340	Sh and Ss (Dakota Ss)	7.60	U G	6.86	15.5		3.64	1.49		0.367	4.07		0.746	**5.56**	0.226	U	0.195	0.0826	U	0.198	0.0292	U	0.0653	ND
20250890825	160-59321-4	38.01	-103.51	8/17/2025	11:45	30	Unk (Alluvium?)	1.18	U	1.70	1.65		0.747	0.849		0.279	0.950		0.394	1.799	0.0686	U	0.140	0.0901	U	0.205	0.00846	U	0.0514	ND
20251010826	160-59606-1	38.01	-104.67	8/18/2025	19:51	507	Ss (Dakota Ss?)	**20.0**	G	5.18	25.9		3.50	8.71		1.03	24.7		2.77	**33.41**	0.757		0.273	0.213	U	0.207	-0.0124	U	0.0224	ND
20251010827	160-59606-2	38.01	-104.74	8/21/2025	8:27	275	Sh and Ss (Graneros Sh and Dakota Ss?)	8.37	G	4.77	9.21		2.27	1.88		0.368	7.64		1.16	**9.52**	0.270		0.210	0.147	U	0.212	-0.00416	U	0.0527	ND
20250110828	160-59606-3	38.05	-103.27	8/25/2025	9:45	36	Sand and Sh (Alluvium and Colorado Group)	**23.1**	G	8.83	5.64		2.78	0.112		0.127	1.07		0.491	1.182	-0.0297	U	0.118	0.0681	U	0.184	0.00333	U	0.0476	ND
20250110829	160-59606-4	38.04	-103.28	8/26/2025	14:00	~300	Sh (Colorado Group?)	**37.0**	G	13.4	6.83	G	4.29	2.25		0.410	4.39		0.819	**6.64**	1.40		0.585	0.296	U	0.345	0.119	U	0.158	ND
20250990830	160-59606-5	38.13	-102.53	8/26/2025	12:00	32.5	Sand, gravel, Sh (Alluvium and Carlile Sh?)	**113**	G	38.4	37.4	G	12.2	0.374		0.161	1.34		0.416	1.714	0.00245	U	0.143	-0.0299	U	0.163	0.0114	U	0.0475	ND
20250110831	160-59606-6	37.80	-102.86	9/1/2025	13:03	360	Black Sh and Ss (Dakota Ss)	5.38	U G	5.83	6.74		2.26	0.130	U	0.144	0.463		0.423	0.463	0.0160	U	0.153	-0.0692	U	0.176	-0.00413	U	0.0540	ND
20250110832	160-59607-1	37.71	-102.95	8/29/2025	11:25	Unk	Unk	**91.7**	G	20.2	30.0	G	6.56	7.41		0.910	5.18		0.937	**12.59**	0.293	U	0.361	0.349	U	0.356	0.103	U	0.160	ND
20250110833	160-59607-2	37.88	-103.14	8/29/2025	13:30	460	Sh and Ss (Dakota/Kiowa/Cheyenne?)	**23.2**	U G	27.5	17.0	U G	12.0	1.65		0.365	1.53		0.625	3.18	-0.0156	U	0.124	0.0591	U	0.189	-0.00554	U	0.0234	ND
20250110834	160-59607-3	37.81	-102.85	9/1/2025	13:19	90?	Ss (Dakota Ss?)	**16.3**	G	6.53	12.7		3.17	1.54		0.319	3.79		0.749	**5.33**	0.224	U	0.199	0.0128	U	0.180	-0.0137	U	0.0249	ND
20250110835	160-59607-4	37.88	-102.82	8/29/2025	12:07	180	Unk	2.42	U G	5.27	18.7		3.43	0.656		0.212	3.07		0.705	3.726	0.189	U	0.181	0.0727	U	0.195	0.0312	U	0.0688	ND
20250890836	160-59607-5	38.13	-104.03	9/10/2025	9:45	31	Unk (Alluvium?)	**34.4**	G	20.0	14.7	G	6.99	0.155		0.116	1.28		0.491	1.435	-0.0451	U	0.150	0.0324	U	0.199	0.0373	U	0.085	ND
20250890837	160-59607-6	38.13	-104.06	9/9/2025	16:30	36	Gravel and clay (Alluvium)	**15.3**	G	7.37	6.16		2.68	0.923		0.298	0.817		0.481	1.74	-0.0886	U	0.141	0.0646	U	0.193	-0.0306	U	0.0303	ND
20250250838	160-59667-1	38.16	-104.04	9/10/2025	10:35	40	Sand, clay, and Sh (Alluvium and Pierre Sh?)	13.2	U G	22.9	-2.90	U G	8.43	0.730		0.288	0.778		0.485	1.508	-0.132	U	0.113	0.132	U	0.208	0.00793	U	0.0497	ND
20251010839	160-59667-2	38.15	-104.72	9/10/2025	10:00	550	Sh and Ss (Graneros Sh and Dakota Ss?)	**47.0**	G	8.96	**54.0**		6.43	10.3		1.27	31.1		3.52	**41.4**	0.870		0.320	-0.0231	U	0.177	0.00460	U	0.0537	ND
20251010840	160-59667-3	38.05	-104.70	9/15/2025	16:00	300	Ss and Sh (Dakota Ss?)	**26.2**	G	7.24	30.3		4.26	6.69		0.939	20.5		2.56	**27.19**	0.903		0.317	0.0481	U	0.179	-0.000466	U	0.0483	ND
20250610841	160-59667-4	38.51	-103.01	9/14/2025	19:00	29	Sand and Sh (Quaternary and Smoky Hill Sh)	11.1	G	4.55	5.38		1.48	0.193	U	0.170	0.338	U	0.372	ND	-0.0718	U	0.139	0.0616	U	0.199	0.00418	U	0.0517	ND
20250270842	160-59667-5	37.99	-105.06	9/16/2025	9:00	144	Red sand (Precambrian)	1.47	U G	1.95	1.47	U	1.41	0.0113	U	0.189	0.649	U	0.443	ND	0.00382	U	0.160	-0.0325	U	0.172	-0.0139	U	0.0252	ND
20251010843	160-59667-6	38.17	-104.71	9/13/2025	9:15	588	Ss and Sh (Dakota Ss?)	**61.2**	G	15.0	**62.9**	G	9.14	9.73		1.23	34.3		3.89	**44.03**	0.841		0.323	0.0159	U	0.181	-0.000256	U	0.0501	ND
20251010844	160-59700-1	37.95	-104.77	9/18/2025	8:30	470	Sh and Ss (Graneros Sh and Dakota Ss?)	8.55	G	4.02	9.26		2.07	4.62		0.617	11.0		1.52	**15.62**	0.00881	U	0.169	0.147	U	0.214	0.00394	U	0.0505	ND
20250890845	160-59700-2	38.00	-103.60	9/17/2025	11:30	670	Sh and Ss (Dakota Ss?)	8.99	U G	8.16	5.88	U G	4.21	0.739		0.216	2.66		0.685	3.399	-0.0163	U	0.178	0.143	U	0.241	0.0681	U	0.102	ND
20251010846	160-59700-3	38.01	-104.76	9/12/2025	13:30	342	Ss and Sh (Dakota Ss?)	**16.1**	G	4.82	24.4		3.44	5.94		0.755	23.0		2.68	**28.94**	0.511		0.262	-0.0423	U	0.172	0.0289	U	0.0647	ND
20251010847	160-59700-4	38.16	-104.12	9/18/2025	11:10	42	Gravel and clay (Alluvium)	7.21	G	4.05	5.10		1.59	0.171	U	0.127	0.952		0.379	0.952	-0.0689	U	0.129	0.102	U	0.201	0.00819	U	0.0505	ND
20250890848	160-59700-5	38.11	-103.87	9/15/2025	9:45	29	Unk (Alluvium?)	**110**	G	29.3	30.5	G	9.05	0.154	U	0.118	0.443	U	0.364	ND	0.0120	U	0.133	-0.0525	U	0.156	0.0112	U	0.0470	ND
20251010849	160-59700-6	38.06	-104.64	9/18/2025	13:30	510	Gray Ss (Dakota Ss?)	**34.6**	G	8.98	47.9		6.49	9.62		1.10	37.4		4.01	**47.02**	0.617		0.266	-0.0306	U	0.162	0.0489	U	0.0759	ND
20250550850	160-59817-1	37.83	-104.95	9/23/2025	9:00	800	Unk	8.85	G	3.41	7.54		1.61	0.525		0.254	0.850		0.488	1.375	-0.0494	U	0.122	0.0981	U	0.202	-0.0141	U	0.0256	ND
20251010851	160-59817-2	37.96	-104.62	9/18/2025	15:30	660	Sh and Ss (Graneros Sh and Dakota Ss?)	**20.3**	G	9.27	22.4	G	4.94	3.51		0.655	17.9		2.12	**21.41**	0.303		0.214	0.151	U	0.204	0.0433	U	0.0737	ND
20251010852	160-59817-3	38.23	-104.52	9/23/2025	17:10	38	Sand, gravel, clay and Sh (Alluvium and Pierre Sh?)	**34.1**	G	11.5	1.42	U G	3.69	0.112	U	0.200	0.770		0.414	0.77	-0.102	U	0.0738	-0.0795	U	0.153	0.00360	U	0.0489	ND
20250890853	160-59817-4	37.96	-103.65	9/23/2025	13:30	602	Sh and Ss (Graneros Sh and Dakota Ss?)	**25.6**	G	9.20	33.9		5.61	7.66		1.05	21.2		2.40	**28.86**	0.242	U	0.195	0.0317	U	0.177	-0.0167	U	0.0246	ND

	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Molybdenum	Nickel	Selenium	Silver	Thallium	Thorium	Tin	Uranium	Vanadium	Zinc
	7	*0.006*	*0.01*	*2*	*0.004*	*1.4*	*0.005*	*0.1*	*0.006*	*1.3*	*14*	*present*	*0.3*	*0.035*	*0.1*	*0.05*	*0.035*	*0.002*	*n/a*	*2.1*	*0.03*	*0.07*	*2*
Sample ID	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L)	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q
20250890801	0.13	ND	ND	0.011	ND	0.47	0.00050	ND	**0.0073**	0.016	0.049 J	0.0014 J	0.17	0.028	0.037	**0.073**	ND	0.00091 J	0.0020	ND	**0.095**	ND	0.057
20250990802	ND	ND	0.0061 J	0.015	ND	0.30	0.00020 J	ND	ND	0.012	1.8	0.0011 J	0.020	0.0096	ND	ND	ND	ND	0.0017 J	ND	0.00053 J	ND	0.023
20250110803	ND	ND	ND	0.0095	ND	0.45	ND	0.0013 J	ND	0.042	0.82	ND	0.0075	0.00092 J	0.0011 J	0.018	ND	ND	0.00071 J	ND	**0.11**	ND	0.071
20250890804	ND	ND	ND	0.011	ND	0.10	ND	ND	ND	0.019	2.4	ND	0.019	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.017 J
20250990805	ND	ND	ND	0.014	ND	0.35	0.00029 J	ND	0.00092 J	ND	0.025 J	ND	**1.0**	0.0041 J	0.0033 J	0.013	ND	ND	ND	ND	0.018	ND	0.49
20250110806	ND	ND	ND	0.014	ND	0.37 B	ND	ND	ND	0.0039	ND	ND	0.065	0.0039 J	0.0021 J	0.017	ND	ND	ND	ND	**0.051**	ND	ND
20250990807	0.30	ND	ND	0.045	ND	0.30	ND	ND	ND	0.065	0.52	0.0034	0.016	0.0021	0.0014	ND	ND	ND	ND	ND	0.0023	ND	0.13
20250610808	ND	ND	ND	0.012	ND	0.51	ND	ND	ND	0.0067	0.029 B	ND	ND	0.0092	ND	0.019	ND	ND	ND	ND	0.026	ND	0.0077 J
20250990809	ND	ND	ND	0.010	ND	0.49	ND	ND	0.00038 J	0.012	9.6	0.0017 J	0.35 B	0.0045 J	0.0013 J	0.0012 J	ND	ND	ND	0.0026 J	**0.051**	ND	0.16
20250990810	ND	ND	0.0040 J	0.049	ND	0.25	ND	ND	ND	ND	0.022 J	ND	ND	0.0041 J	ND	0.014	ND	ND	ND	ND	0.026	0.027	0.012 J
20250610811	ND	ND	ND	0.012	ND	0.48	ND	0.0016 J	ND	0.0018 J	ND	ND	ND	**0.040**	ND	**0.25**	ND	ND	ND	ND	**0.040**	0.0073 J	0.0086 J
20251010812	ND	ND	ND	0.024	ND	0.13	ND	ND	ND	0.011	0.23	0.0022 J	0.0087	0.0085	0.0019 J	0.017	ND	ND	ND	ND	**0.038**	ND	0.19
20251010813	ND	ND	ND	0.020	ND	0.23	ND	ND	ND	0.026	ND	ND	ND	0.0035 J	0.0028 J	0.013	ND	ND	ND	ND	0.0092	ND	ND
20250990814	ND	ND	ND	0.022	ND	0.44	ND	ND	ND	0.0020 J	0.029 J B	ND	0.011	0.0010 J	0.0019 J	0.019	ND	ND	ND	ND	**0.036**	ND	0.0086 J
20251010815	ND	ND	ND	0.047	ND	0.046 J	ND	ND	ND	0.0049	ND	ND	ND	0.0068	ND	**0.051**	ND	ND	ND	ND	0.017	ND	ND
20250990816	ND	ND	ND	0.013	ND	0.46	ND	ND	ND	0.018	0.024 J	ND	0.011	0.0016 J	0.0030 J	0.0091	ND	ND	ND	ND	**0.035**	ND	0.017 J
20251010817	ND	ND	ND	0.017	ND	0.051 J	ND	ND	ND	0.0097	2.2	ND	0.14	0.0046 J	ND	ND	ND	ND	ND	ND	ND	ND	0.010 J
20250890818	ND	ND	ND	0.012	ND	0.15	0.00022 J	ND	0.00041 J	0.0093	ND	ND	**0.61**	0.0089	0.0036 J	0.0058	ND	ND	ND	ND	0.018	ND	0.025
20251010819	3.6	ND	**0.044**	0.031	0.0015	0.16	ND	0.043	0.0037	0.083	**69**	0.0077	0.24	0.0066	0.014	0.0010 J	ND	ND	0.0036	0.0036 J	0.00092 J	0.0046 J	**2.4**
20250110820	0.12	0.0013 J	0.0052 J	0.15	ND	0.48	ND	0.031	0.0035	0.094	**65**	ND	**0.39**	0.0030 J	0.023	ND	ND	ND	ND	0.0089	ND	ND	0.19
20250110821	ND	ND	ND	0.011	ND	0.48	ND	ND	ND	0.0078	0.044 J	ND	0.0033 J	0.0053	0.0021 J	0.024	ND	ND	ND	ND	**0.063**	ND	0.052
20250990822	ND	ND	ND	0.0084	ND	0.16	ND	ND	ND	ND	0.051	ND	0.017	0.0020 J	ND	ND	ND	ND	ND	0.00079 J	0.00020 J	ND	0.011 J
20250990823	ND	ND	0.0030 J	0.010	ND	0.35	ND	ND	ND	0.0018 J	1.3	ND	0.0037 J	0.0096	ND	0.011	ND	ND	ND	ND	0.024	0.014	0.17
20250990824	ND	ND	ND	0.0080	0.00025 J	0.21	ND	ND	ND	0.0032	2.5	ND	0.084	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
20250890825	ND	ND	0.0022 J	0.23	ND	0.014 J	ND	ND	ND	0.013	2.8	ND	0.10	ND	ND	ND	ND	ND	ND	ND	0.00024 J	ND	0.015 J
20251010826	ND	ND	ND	0.012	ND	0.065	ND	0.039	ND	0.0039	1.6	ND	0.048	0.011	0.0012 J	ND	ND	ND	ND	0.0012 JB	ND	ND	0.040
20251010827	ND	ND	ND	0.015	ND	0.046 J	0.00029 J	ND	ND	0.0065	0.57	ND	0.17	0.0089	ND	ND	ND	ND	ND	0.0016 JB	0.00027 J	ND	0.015 J
20250110828	0.20	ND	ND	0.013	ND	0.17	ND	ND	ND	0.027	0.40	0.0023 J	0.020	0.029	0.0020 J	0.0068	ND	ND	ND	0.0014 JB	0.019	ND	0.058
20250110829	1.9	ND	ND	0.022	0.00034 J	0.14	ND	0.0049 J	0.00050 J	0.0087	5.6	0.0019 J	0.018	ND	0.0015 J	ND	ND	ND	0.00098 J	0.0012 JB	ND	ND	0.027
20250990830	ND	ND	ND	0.014	ND	1.4	ND	ND	0.00028 J	0.057	0.13	0.0013 J	ND	**0.070**	0.0095	**0.083**	ND	ND	ND	0.0014 JB	**0.13**	ND	0.27
20250110831	ND	ND	ND	0.011	ND	0.16	ND	ND	ND	0.0075	ND	ND	ND	0.014	ND	0.0086	ND	ND	ND	0.00084 JB	0.010	ND	0.024
20250110832	0.26	ND	0.0031 J	0.018	ND	0.25	0.00038 J	0.0020 J	0.0030	0.0065	**18**	0.0037	0.063	0.022	0.0051	**0.057**	ND	ND	ND	0.00089 JB	**0.073**	ND	0.20
20250110833	0.051 J	ND	ND	0.014	ND	0.32	ND	0.0016 J	ND	0.019	1.6	0.0021 J	0.034	0.0051	0.00092 J	ND	ND	ND	ND	0.00092 JB	0.00083 J	ND	0.016 J
20250110834	ND	ND	ND	0.0087	0.00053	0.15	ND	ND	0.00041 J	ND	6.6	ND	**0.33**	0.0022 J	0.0012 J	ND	ND	ND	ND	ND	0.0018	ND	ND
20250110835	ND	ND	ND	0.0069	0.00027 J	0.19	ND	ND	ND	ND	5.8	ND	0.19	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
20250890836	ND	ND	ND	0.016	ND	0.53	ND	ND	ND	0.019	0.070	0.0028 J	0.0036 J	0.021	0.0030 J	0.023	ND	ND	ND	0.0012 JB	**0.063**	ND	0.20
20250890837	ND	ND	ND	0.011	ND	0.12	ND	ND	ND	0.061	0.020 J	0.0011 J	ND	0.0084	0.0017 J	0.013	ND	ND	ND	0.00078 JB	0.021	ND	0.032
20250250838	ND	ND	ND	0.0091	ND	0.81	**0.017**	ND	0.0033	0.013	0.30	ND	**2.0**	0.0019 J	0.029	0.0013 J	ND	ND	ND	0.00081 JB	0.0028	ND	0.033
20251010839	ND	ND	ND	0.021	ND	0.067 J	ND	ND	ND	0.0083	1.9	0.0013 J	0.088	0.00059 J	0.0014 J	ND	ND	ND	ND	ND	ND	ND	0.16
20251010840	ND	ND	0.0017 J	0.012	ND	0.064 J	ND	ND	ND	0.0099	1.8	ND	0.060	0.0077	ND	ND	ND	ND	ND	ND	ND	ND	0.040
20250610841	ND	ND	ND	0.029	ND	0.29	ND	ND	ND	0.0026 J	0.053	ND	0.0050	0.021	ND	0.0084	ND	ND	ND	ND	0.018	ND	0.0079 J
20250270842	ND	ND	ND	0.064	ND	0.010 J	ND	ND	ND	0.0029 J	0.38	ND	0.065	ND	ND	ND	ND	ND	ND	ND	0.00045 J	ND	0.011 J
20251010843	ND	ND	ND	0.010	0.00020 J	0.11	ND	ND	ND	0.0030	4.4	ND	0.11	0.0011 J	ND	ND	ND	ND	ND	0.00079 JB	ND	ND	0.18
20251010844	ND	ND	ND	0.074	ND	0.062 J	ND	ND	ND	1.1	0.16	0.25	0.016	0.0067	ND	ND	ND	ND	ND	0.0063 B	0.0035	ND	0.023
20250890845	ND	ND	ND	0.039	ND	0.14	ND	ND	ND	0.0021 J	0.44	ND	0.011	ND	ND	ND	ND	ND	ND	0.0014 JB	ND	ND	0.018 J
20251010846	ND	ND	ND	0.050	ND	0.028 J	ND	ND	ND	ND	0.37	ND	0.083	0.0064	ND	ND	ND	ND	ND	0.0010 JB	ND	ND	ND
20251010847	ND	ND	ND	0.015	ND	0.098 J	ND	ND	ND	0.0078	0.046 J	ND	0.0043 J	0.0049 J	0.0016 J	0.0080	ND	ND	ND	0.00094 JB	0.0095	ND	ND
20250890848	ND	ND	ND	0.014	ND	0.42	ND	ND	ND	0.0015 J	0.52	ND	0.0048 J	0.014	0.0022 J	0.033	ND	ND	ND	0.00083 JB	**0.12**	ND	ND
20251010849	ND	ND	ND	0.016	ND	0.079 J	ND	ND	ND	0.018	1.3	0.0021 J	0.082	0.0056	ND	ND	ND	ND	ND	0.00084 JB	ND	ND	0.014 J
20250550850	0.73	ND	ND	0.068	0.00025 J	0.072 J	ND	ND	0.0020	0.0054	0.69 B	0.0031	**0.64**	0.021	0.0043 J	0.00068 J	ND	ND	ND	0.00096 J	0.00061 J	ND	0.55
20251010851	ND	ND	0.0029 J	0.011	0.00059	0.082 J	ND	ND	**0.028**	0.013	14 B	ND	**1.2**	ND	0.042	ND	ND	ND	ND	0.00096 J	ND	ND	0.11
20251010852	ND	ND	ND	0.0097	ND	0.13	ND	ND	ND	0.0092	0.029 J B	0.0020 J	ND	0.0021 J	0.0018 J	0.017	ND	ND	ND	ND	**0.032**	ND	0.091
20250890853	ND	ND	ND	0.0094	ND	0.094 J	ND	ND	ND	ND	5.8 B	ND	0.18	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.052

								Gross Alpha			Gross Beta			Radium-226			Radium-228			Ra-226+228	Thorium-228			Thorium-230			Thorium-232			Th-230+232
				Sample		Well	DWG[1] :	15			50			--->			--->			5	--->			--->			--->			60
Sample ID	Lab ID	Latitude	Longitude	Date	Time	Depth	Geology[2]/Units	(pica/L)	Q	2σ(±)[3]	(pica/L)	Q	2σ(±)[3]	(pica/L)	Q	2σ(±)[3]	(pica/L)	Q	2σ(±)[3]	(pica/L)	(pica/L)	Q	2σ(±)[3]	(pica/L)	Q	2σ(±)[3]	(pica/L)	Q	2σ(±)[3]	(pica/L)
20250890854	*160-59817-5*	38.05	-103.74	9/25/2025	7:30	45	*Unk (Alluvium?)*	**87.9**	G	21.2	30.4	G	7.23	0.0420	U	0.150	-0.0981	U	0.390	ND	-0.0963	U	0.138	-0.0434	U	0.179	0.0282	U	0.0718	ND
20251010855	*160-59817-6*	37.95	-104.74	9/21/2025	8:30	550	*Sh and Ss (Graneros Sh and Dakota Ss?)*	10.5	G	3.76	12.4		2.16	5.70		0.911	9.67		1.42	**15.37**	0.142	U	0.188	-0.0419	U	0.166	0.0351	U	0.0678	ND
20250550856	*160-59865-1*	37.92	-104.95	9/26/2025	12:39	108	*Sand, gravel, clay, Sh (Carlile Sh?)*	1.49	U	1.06	0.600	U	0.509	0.218	U	0.232	0.129	U	0.360	ND	-0.137	U	0.124	0.149	U	0.224	0.00956	U	0.0551	ND
20251010857	*160-59865-2*	38.11	-104.46	9/17/2025	16:30	Unk	*Unk*	-0.959	U G	4.71	11.5	G	3.65	1.25		0.384	0.772		0.452	2.022	-0.133	U	0.150	0.224	U	0.249	-0.0197	U	0.0288	ND
20251010858	*160-59865-3*	38.01	-104.75	9/28/2025	12:01	325	*Ss (Dakota Ss?)*	**16.0**	G	4.55	22.9		3.28	6.94		1.02	21.7		2.51	**28.64**	0.137	U	0.197	0.0564	U	0.197	-0.0140	U	0.0255	ND
20251010859	*160-59865-4*	38.12	-104.77	9/28/2025	11:45	514	*Dakota Ss?*	1.78	U G	1.98	6.29		1.33	0.299	U	0.238	0.777		0.416	0.777	0.0459	U	0.169	0.161	U	0.219	0.00883	U	0.0527	ND
20251010860	*160-59865-5*	37.94	-104.78	10/1/2025	11:57	720	*Sh and Ss (Kiowa and Cheyenne?)*	**24.7**	G	7.13	3.75		2.11	0.578		0.276	0.273	U	0.380	0.578	-0.127	U	0.123	0.160	U	0.214	0.0121	U	0.0493	ND
20251010861	*160-59865-6*	38.12	-104.71	9/29/2025	8:00	505	*Ss (Dakota Ss?)*	**17.3**	G	6.60	37.8		5.46	8.03		1.12	32.2		3.49	**40.23**	0.315		0.220	0.147	U	0.212	-0.0138	U	0.0251	ND
20250270862	*160-59929-1*	38.02	-105.07	10/5/2025	10:00	250	*Granite (Precambrian)*	5.42	G	2.63	4.22		1.15	0.392		0.226	1.07		0.482	1.462	0.0228	U	0.177	0.107	U	0.216	0.0064	U	0.0757	ND
20250250863	*160-59929-2*	38.22	-103.87	10/5/2025	8:20	33	*Unk (Quaternary?)*	6.84	U G	6.43	3.94		2.49	0.0627	U	0.217	1.04		0.477	1.04	-0.127	U	0.122	-0.00984	U	0.18	0.000425	U	0.0559	ND
20251010864	*160-59929-3*	38.06	-104.63	10/5/2025	18:00	323	*Ss and Sh (Dakota Ss?)*	**23.3**	G	7.58	26.2		4.2	8.99		1.21	16.9		1.97	**25.89**	0.173	U	0.195	-0.0531	U	0.164	0.00815	U	0.0504	ND
20250610865	*160-59929-4*	38.45	-102.56	9/21/2025	18:30	30	*Unk (Alluvium?)*	**24.7**	G	12.4	14.0	G	5.15	0.133	U	0.188	0.452	U	0.357	ND	0.0535	U	0.326	0.0879	U	0.318	-0.0326	U	0.0452	ND
20251010866	*160-59929-5*	38.01	-104.77	10/2/2025	16:00	520	*Sh and Ss (Graneros Sh and Dakota Ss?)*	5.95	G	2.63	12.0		1.87	3.37		0.648	8.76		1.25	**12.13**	0.363		0.26	-0.117	U	0.158	0.11	U	0.115	ND
20250550867	*160-59929-6*	37.85	-104.74	10/8/2025	11:25	400	*Ss and Sh (Carlile Sh?)*	13.2	G	7.00	17.4		3.45	4.46		0.747	13.7		1.72	**18.16**	0.193	U	0.393	-0.04	U	0.267	-0.0413	U	0.0484	ND
20250990868	*160-59928-1*	37.99	-102.14	10/3/2025	14:30	147	*Sand, clay and Sh (Ogallala Fm.?)*	7.37	G	5.08	10.0		2.74	0.0169	U	0.159	0.902		0.424	0.902	0.0255	U	0.173	0.0307	U	0.196	0.0368	U	0.0704	ND
20250890869	*160-59928-2*	38.11	-104.02	10/4/2025	7:30	24	*Sand, gravel and clay (Alluvium)*	**25.4**	G	10.8	12.1	G	4.49	0.271	U	0.222	1.76		0.506	1.76	0.114	U	0.186	0.153	U	0.226	0.0285	U	0.0725	ND
20251010870	*160-59928-3*	37.88	-104.81	10/8/2025	16:05	418	*Ss and clay (Dakota Ss?)*	6.29	U G	4.74	6.07		2.64	0.282	U	0.209	0.702		0.362	0.702	0.0873	U	0.174	0.0308	U	0.202	-0.0150	U	0.0272	ND
20251010871	*160-59928-4*	37.96	-104.65	10/9/2025	12:30	385	*Gray and white Ss (Dakota Ss?)*	**43.7**	G	10.9	47.5		6.41	10.3		1.34	28.0		3.05	**38.3**	0.506		0.259	-0.0547	U	0.171	-0.0230	U	0.0287	ND
20251010872	*160-59928-5*	38.09	-104.63	10/7/2025	18:12	225	*Sh and Ss (Graneros Sh and Dakota Ss?)*	**31.4**	G	6.96	39.6		4.98	7.20		1.05	26.5		2.93	**33.7**	0.535		0.270	-0.0144	U	0.180	-0.0145	U	0.0263	ND
20251010873	*160-59928-6*	37.91	-104.92	10/8/2025	10:45	100	*Loose sand and gravel (Quaternary?)*	0.150	U	1.31	1.83		0.725	-0.0355	U	0.148	0.175	U	0.337	ND	0.0252	U	0.214	-0.0493	U	0.208	0.0031	U	0.0788	ND
20251010874	*160-60097-1*	37.95	-104.97	10/12/2025	17:30	125	*Blue Sh (Carlile/Graneros?)*	1.52	U G	3.46	4.07		1.55	0.483		0.245	0.604	U	0.467	0.483	0.00535	U	0.154	0.167	U	0.228	0.0110	U	0.0758	ND
20250990875	*160-60097-2*	37.84	-102.47	10/11/2025	10:00	100	*Ss (Dakota Ss)*	5.44		2.37	4.21		1.15	0.583		0.270	0.859		0.504	1.442	-0.0382	U	0.179	0.0845	U	0.230	0.0187	U	0.0660	ND
20250110876	*160-60097-3*	38.08	-102.77	10/10/2025	17:00	59	*Gravel and Ss (Alluvium)*	-3.11	U G	8.59	9.22	G	3.55	1.16		0.353	3.41		0.769	4.57	0.263	U	0.229	-0.0197	U	0.181	0.00586	U	0.0725	ND
20250110877	*160-60097-4*	38.06	-102.93	10/15/2025	12:30	137?	*White Ss? (Dakota Ss?)*	**40.4**	G	17.5	26.4	G	6.65	6.12		0.890	5.69		0.952	**11.81**	0.142	U	0.206	-0.0683	U	0.171	0.0359	U	0.0917	ND
20250110878	*160-60097-5*	38.11	-102.80	10/15/2025	15:20	32	*Unk (Quaternary?)*	**128**	G	35.4	44.1	G	11.0	0.136	U	0.183	0.304	U	0.405	ND	-0.102	U	0.143	-0.0517	U	0.166	0.00372	U	0.0495	ND
20251010879	*160-60097-6*	38.23	-104.06	10/15/2025	14:00	110	*Sand and Sh (Quaternary and Pierre Sh?)*	**21.4**	G	6.09	6.99		2.05	0.0376	U	0.145	1.24		0.614	1.24	-0.0298	U	0.162	0.161	U	0.231	-0.0197	U	0.0288	ND
20251010880	*160-60199-1*	38.10	-104.43	10/15/2025	12:00	Unk	*Unk*	**74.1**	G	48.6	**74.9**	G	22.7	0.581		0.296	3.99	G	1.37	4.571	-0.00763	U	0.489	0.176	U	0.391	0.119	U	0.297	ND
20250990881	*160-60199-2*	38.23	-102.65	10/7/2025	21:00	Unk	*Unconsolidated (Quaternary?)*	9.94	G	5.18	5.90		2.12	0.351		0.193	1.28	G	0.743	1.631	-0.0361	U	0.187	0.0670	U	0.224	0.0341	U	0.0838	ND
20250610882	*160-60199-3*	38.53	-102.60	10/15/2025	8:30	49	*Sand and Sh (Quaternary and Smoky Hill Sh)*	**48.9**	G	19.4	15.5	G	6.55	0.0102	U	0.0846	1.96		0.730	1.96	0.0391	U	0.160	0.140	U	0.218	-0.0183	U	0.0269	ND
20250990883	*160-60199-4*	38.24	-102.53	10/21/2025	15:00	124	*Clay, limestone and Sh (Fort Hays Limestone)*	**42.7**	G	20.8	22.7	G	7.87	0.142	U	0.126	2.13		0.661	2.13	-0.0551	U	0.125	-0.0137	U	0.195	0.00102	U	0.061	ND
20250250884	*160-60199-5*	38.18	-103.89	10/18/2025	13:20	34	*Unk (Quaternary?)*	**127**	G	50.4	28.4	G	16.7	0.267		0.147	1.74		0.626	2.007	-0.0874	U	0.105	-0.0174	U	0.178	0.00908	U	0.0535	ND
20251010885	*160-60199-6*	38.12	-104.71	10/25/2025	13:39	~500	*Unk*	8.40	G	4.23	16.8		2.90	3.10		0.489	10.2		1.52	**13.3**	0.185	U	0.196	-0.0344	U	0.175	-0.0126	U	0.0555	ND
20250890886	*160-60267-1*	38.09	-103.78	10/22/2025	9:00	35	*Gravel and Sh (Alluvium and Smoky Hill Sh?)*	**19.6**	G	8.04	8.52	G	3.40	0.0758	U	0.149	0.00567	U	0.417	ND	0.00487	U	0.132	0.107	U	0.218	-0.0201	U	0.0293	ND
20251010887	*160-60267-2*	37.98	-104.64	10/20/2025	13:00	365	*Ss (Dakota Ss?)*	**23.8**	G	7.55	47.2	G	6.92	11.2		1.35	45.6		4.79	**56.8**	1.40		0.415	0.172	U	0.218	-0.0227	U	0.0284	ND
20250270888	*160-60267-3*	38.01	-105.06	10/27/2025	16:12	Unk	*Unk*	0.688	U	1.27	2.81		1.12	0.00331	U	0.110	0.398	U	0.464	ND	-0.123	U	0.203	0.0961	U	0.298	0.0253	U	0.138	ND
20250890889	*160-60267-4*	38.00	-103.55	10/16/2025	15:10	39	*Unk (Alluvium?)*	**15.7**	G	6.69	11.2	G	4.05	0.225	U	0.225	1.09		0.647	1.09	-0.00776	U	0.344	0.0398	U	0.315	-0.0590	U	0.123	ND
20250610890	*160-60267-5*	38.47	-102.08	11/2/2025	9:30	85?	*Gravel*	**42.0**	G	13.2	13.6	G	5.40	0.273	U	0.222	0.249	U	0.445	ND	-0.0703	U	0.300	0.0502	U	0.304	-0.0328	U	0.0455	ND
20250250891	*160-60465-1*	38.40	-103.72	11/19/2025	13:25	22	*Unk (Quaternary?)*	**52.5**	G	29.0	16.7	G	8.83	0.100	U	0.104	0.272	U	0.350	ND	0.0493	U	0.180	0.0595	U	0.202	0.0106	U	0.0738	ND

NOTES:

[1] DWG are drinking water guidelines. Results greater than these guidelines are bolded.

[2] Geology is based on well driller's log where available, well owner reported information, report OF-19-11 subcrop map and interpretations based on surface geology and wells lithology. Ss = Sandstone. Sh = Shale. Interpreted formations and depth uncertainties are marked with ?

[3] Radionuclide total uncertainty value (2 sigma) shown as 2σ(±).

Q = Lab qualifiers: U = Result is less than the sample detection limit (i.e., not detected (ND)), G = The sample Minimum Detectable Concentration (MDC) is greater than the requested Reporting Limit (RL)

J = Result is less than the Reporting Limit (RL) but greater than or equal to the Method Detection Limit (MDL), and the concentration is an approximate value, B = Compound was found in the lab blank and sample

^1+ = Initial Calibration Verification (ICV) is outside acceptance limits, high biased.

Radionuclide data values preceded by minus sign "-" are equivalent to ND.

Sample ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Molybdenum	Nickel	Selenium	Silver	Thallium	Thorium	Tin	Uranium	Vanadium	Zinc
	7	*0.006*	*0.01*	*2*	*0.004*	*1.4*	*0.005*	*0.1*	*0.006*	*1.3*	*14*	*present*	*0.3*	*0.035*	*0.1*	*0.05*	*0.035*	*0.002*	*n/a*	*2.1*	*0.03*	*0.07*	*2*
	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L)	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q	(mg/L) Q
20250890854	ND	ND	ND	0.011	ND	0.32	ND	ND	ND	0.0093	0.031 J B	ND	0.0033 J	0.010	0.0013 J	0.021	ND	ND	ND	0.00088 J	**0.054**	ND	0.25
20251010855	ND	ND	ND	0.051	ND	0.023 J	ND	ND	ND	0.027	ND	ND	0.011	0.011	ND	ND	ND	ND	ND	0.0070	0.0020	ND	0.033
20250550856	ND	ND	ND	0.055	ND	0.015 J ^1+	ND	ND	ND	0.0079	ND	ND	ND	0.00063 J	ND	0.0013 J	ND	ND	0.00082 J	ND	0.00040 J	ND	0.013 J
20251010857	0.055 J	ND	ND	0.0015 J	ND	0.099 J ^1+	ND	ND	ND	0.0020 J	0.20	ND	0.0025 J	0.014	ND	ND	ND	ND	0.00064 J	0.0018 J	ND	ND	ND
20251010858	ND	ND	ND	0.056	ND	0.032 J ^1+	ND	ND	ND	ND	0.35	ND	0.098	0.0058	ND	ND	ND	ND	ND	ND	ND	ND	0.0088 J
20251010859	0.11	ND	0.0018 J	0.0059	ND	0.061 J ^1+	ND	0.0015 J	0.00034 J	0.0023 J	1.4	ND	0.013	**0.15**	0.0034 J	ND	ND	ND	ND	ND	ND	ND	0.021
20251010860	ND	ND	ND	0.014	ND	0.091 J ^1+	ND	ND	ND	0.036	0.13 J	0.0013	0.016	0.019	ND	ND	ND	ND	ND	ND	0.0093	ND	0.065
20251010861	ND	ND	0.0017 J	0.015	ND	0.050 J ^1+	ND	ND	ND	0.0081	2.7	0.0012 J	0.15	0.0026 J	0.0012 J	ND	ND	ND	ND	ND	ND	ND	0.049
20250270862	0.25	ND	ND	0.039	ND	ND	ND	ND	ND	0.21	0.18 B	0.0018 J	0.083	0.0015 J	0.0028 J B	ND	ND	ND	ND	ND	0.0033	ND	0.25
20250250863	ND	ND	ND	0.013	ND	0.47	ND	ND	ND	0.0022 J	0.23 B	ND	0.02	0.0089	0.0041 J B	**0.093**	ND	ND	ND	0.0014 J	0.016	ND	0.022
20251010864	ND	ND	ND	0.0088	ND	0.079 J	ND	ND	ND	ND	2.5 B	ND	0.091	0.0042 J	ND	ND	ND	ND	ND	0.0028 J	ND	ND	0.018 J
20250610865	ND	ND	ND	0.0088	ND	0.7	ND	0.013 B	0.00048 J	0.026	13 B	0.001 J	0.1	0.01	0.0057 B	**0.083**	ND	ND	ND	ND	**0.035**	ND	0.14
20251010866	ND	ND	ND	0.05	ND	0.045 J	ND	ND	ND	0.029	0.09 B	0.0027 J	0.042	0.0066	ND	ND	ND	ND	ND	0.0034 J	ND	ND	0.05
20250550867	0.077 J	ND	ND	0.031	ND	0.18 J	ND	ND	ND	0.077	0.096 B	0.0024 J	0.071	0.0013 J	0.0019 J B	ND	ND	ND	ND	ND	ND	ND	0.25
20250990868	ND	ND	0.0017 J	0.023	ND	0.11 J	ND	0.0018 J B	ND	0.0020 J	0.087 B	ND	0.0027 J	0.0060	ND	0.022	ND	ND	ND	ND	0.0089	0.0068 J	0.061
20250890869	ND	ND	ND	0.031	ND	0.24 J	ND	ND	ND	0.011	0.046 J B	ND	0.0023 J	0.012	0.0036 J B	**0.062**	ND	ND	ND	ND	0.028	ND	0.10
20251010870	ND	ND	ND	0.087	ND	0.19 J	ND	ND	ND	0.0031	0.30 B	ND	0.10	0.0017 J	0.0011 J B	ND	ND	ND	ND	ND	0.0055	ND	0.25
20251010871	0.052 J	ND	0.0040 J	0.013	ND	0.11 J	ND	ND	ND	0.029	3.0 B	ND	0.081	0.0047 J	0.0010 J B	ND	ND	ND	ND	ND	ND	ND	0.060
20251010872	ND	ND	0.0040 J	0.011	ND	0.069 J	ND	ND	**0.011**	0.0026 J	6.4 B	0.0014 J	0.12	0.0060	0.017 B	ND	ND	ND	ND	ND	ND	ND	0.047
20251010873	ND	ND	ND	0.066	ND	0.029 J	ND	ND	ND	0.020	ND	ND	ND	0.0013 J	ND	ND	ND	ND	ND	0.011	0.00069 J	ND	0.016 J
20251010874	ND	ND	ND	0.038	ND	0.72	ND	ND	ND	0.058	0.096	0.0012 J	0.0076	0.0014 J	ND	ND	ND	ND	ND	ND	0.00087 J	ND	0.025
20250990875	ND	ND	ND	0.015	ND	0.098 J	ND	ND	ND	0.020	1.2	0.0016 J	0.0047 J	0.0046 J	0.0018 J	0.0063	ND	ND	ND	ND	0.0013	ND	0.073
20250110876	ND	ND	ND	0.036	ND	0.078 J	ND	ND	ND	0.0078	1.1	0.0012 J	0.10	0.0030 J	ND	ND	ND	ND	ND	ND	ND	ND	0.016 J
20250110877	ND	ND	ND	0.0083	ND	0.21	ND	ND	0.00098 J	0.0021 J	1.1	0.0020 J	0.19	0.0022 J	ND	0.0015 J	ND	ND	ND	ND	0.0048	ND	0.013 J
20250110878	ND	ND	ND	0.0057	ND	0.86	ND	ND	ND	0.0017 J	0.077	ND	ND	0.015	0.0015 J	0.035	ND	ND	ND	ND	**0.14**	ND	ND
20251010879	ND	ND	ND	0.023	ND	0.30	ND	ND	ND	0.0039	ND	ND	ND	0.015	ND	0.023	ND	ND	ND	ND	0.017	ND	ND
20251010880	0.97	ND	ND	0.029	ND	0.70	0.00020 J	0.0013 J B	0.0013 J	0.0060	4.9 B	ND	0.27	0.015	0.0076 B	**0.053**	ND	ND	ND	ND	0.029	0.0057 J	0.015 J
20250990881	ND	ND	ND	0.014	ND	0.22	ND	0.0024 J B	ND	0.028	1.9 B	0.0035	0.0078	0.012	0.0033 J B	0.012	ND	ND	ND	0.00076 J	0.013	0.0091 J	0.35
20250610882	0.054 J	ND	ND	0.0086	ND	0.55	ND	ND	ND	0.0038	0.12 B	0.0023 J	0.0037 J	0.0053	ND	**0.058**	ND	ND	ND	ND	**0.036**	ND	0.23
20250990883	0.11	ND	0.0080 J	0.0064	ND	0.67	ND	0.0079 J B	ND	0.086	6.5 B	0.0070	0.0094	0.026	0.0016 J B	**0.10**	ND	ND	ND	0.0015 J	**0.050**	0.037	0.063
20250250884	0.34	ND	ND	0.0078	ND	**1.9**	ND	0.0019 J B	0.00037 J	0.0068	0.45 B	ND	0.013	0.0071	0.0015 J B	**0.59**	ND	ND	ND	ND	**0.11**	ND	0.051
20251010885	ND	ND	ND	0.019	ND	0.095 J	ND	ND	ND	0.0061	1.5 B	ND	0.11	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.027
20250890886	ND	ND	ND	0.021	ND	0.20	ND	ND	ND	0.12	0.27	ND	0.0034 J	0.010	0.0016 J	0.011 B	ND	ND	ND	0.0030 J	**0.031**	ND	0.056
20251010887	ND	ND	0.0024 J	0.016	ND	0.083 J	ND	ND	0.00032 J	0.033	3.5	0.0025 J	0.11	0.0034 J	ND	ND	ND	ND	ND	0.014	ND	ND	0.022
20250270888	ND	ND	ND	0.065	ND	ND	ND	ND	ND	0.043	0.27	0.0020 J	0.0029 J	0.00094 J	0.0012 J	0.0013 J B	ND	ND	ND	ND	0.0014	ND	0.016 J
20250890889	0.080 J	ND	ND	0.027	ND	0.18	ND	ND	ND	0.066	0.045 J	0.0029 J	ND	0.0041 J	0.0024 J	0.0074 B	ND	ND	ND	0.00089 J	0.016	ND	0.16
20250610890	ND	ND	0.0059 J	0.021	ND	0.94	ND	ND	ND	0.0018 J	0.029 J	ND	ND	0.034	ND	0.037 B	ND	ND	0.00072 J	0.0011 J	**0.050**	0.058	0.016 J
20250250891	0.082 J	ND	ND	0.012	ND	**1.5**	ND	ND	0.00029 J	0.53	0.073	0.0028 J	0.0031 J	0.0070	0.0014	**0.14** J	ND	ND	ND	0.0030 J	**0.061**	ND	0.44

NOTES:

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Q = Lab qualifiers: U = Result is less than the sample detection limit (i.e., not detected (ND)), G = The sample Minimum Detectable Concentration (MDC) is greater than the requested Reporting Limit (RL)

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^1+ = Initial Calibration Verification (ICV) is outside acceptance limits, high biased.

Radionuclide data values preceded by minus sign "-" are equivalent to ND.

								Gross Alpha EPA Method 900.0				Gross Alpha SM7110C Method			
				Sample		Well	***DWG* [1] *:***	***15***				***15***			
Sample ID	Lab ID	Latitude	Longitude	Date	Time	Depth	Geology[2]/Units	(pCi/L)	Q	2σ(±)[3]	MDC	(pCi/L)	Q	2σ(±)[3]	MDC
20250890801	*160-58685-1*	38.01	-103.67	6/13/2025	13:30	30	*Unk (Alluvium?)*	**101**	G	27.3	24.1	**65.9**		8.84	1.38
20250110803	*160-58685-3*	38.09	-103.20	6/19/2025	14:35	61	*Gravel and Sh (Alluvium and Benton Group?)*	**99.6**	G	24.6	15.1	**77.7**		10.1	1.14
20250110806	*160-58685-6*	38.06	-103.27	6/15/2025	19:40	Unk	*Unk*	**38.6**	G	15.1	17.1	**32.0**		4.48	1.05
20250990809	*160-58925-3*	38.07	-102.61	7/9/2025	6:45	110?	*Dakota Ss?*	**50.0**	G	23.6	25.0	**25.7**		3.77	1.12
20251010812	*160-58925-6*	38.26	-104.51	7/15/2025	18:05	27	*Gravel and Sh (Quaternary and Pierre Sh?)*	**28.8**	G	15.9	21.9	**22.7**		3.41	1.29
20250990814	*160-59052-2*	38.10	-102.63	7/18/2025	7:30	30	*Sand and gravel (Alluvium)*	**51.2**	G	22.8	29.9	**20.7**		3.17	1.08
20250990816	*160-59052-4*	38.09	-102.62	7/19/2025	13:50	22	*Alluvium*	**39.5**	G	21.3	29.7	**16.3**		2.63	1.00
20251010819	*160-59163-2*	38.18	-104.78	7/21/2025	12:45	Unk	*Unk*	**68.5**	G	18.7	16.4	**175**		22.0	2.87
20250110821	*160-59163-4*	38.07	-103.36	8/4/2025	9:15	24	*Unk (Alluvium?)*	**81.8**	G	23.8	21.3	**42.6**		5.75	1.26
20250990830	*160-59606-5*	38.13	-102.53	8/26/2025	12:00	32.5	*Sand, gravel, Sh (Alluvium and Carlile Sh?)*	**113**	G	38.4	44.1	**68.7**		8.69	1.05
20250110833	*160-59607-2*	37.88	-103.14	8/29/2025	13:30	460	*Sh and Ss (Dakota/Kiowa/Cheyenne?)*	**23.2**	U G	27.5	45.0	**15.3**		2.51	1.02
20250890836	*160-59607-5*	38.13	-104.03	9/10/2025	9:45	31	*Unk (Alluvium?)*	**34.4**	G	20.0	27.8	**33.5**		5.20	1.79
20250250838	*160-59667-1*	38.16	-104.04	9/10/2025	10:35	40	*Sand, clay, and Sh (Alluvium and Pierre Sh?)*	13.2	U G	22.9	39.6	3.44		1.08	1.09
20250890848	*160-59700-5*	38.11	-103.87	9/15/2025	9:45	29	*Unk (Alluvium?)*	**110**	G	29.3	25.8	**84.6**	G	13.4	5.08
20250890854	*160-59817-5*	38.05	-103.74	9/25/2025	7:30	45	*Unk (Alluvium?)*	**87.9**	G	21.2	16.0	**23.0**		3.55	0.821
20250610865	*160-59929-4*	38.45	-102.56	9/21/2025	18:30	30	*Unk (Alluvium?)*	**24.7**	G	12.4	15.2	**16.5**		3.73	2.51
20250110876	*160-60097-3*	38.08	-102.77	10/10/2025	17:00	59	*Gravel and Ss (Alluvium)*	-3.11	U G	8.59	17.1	6.43		1.52	0.916
20250110877	*160-60097-4*	38.06	-102.93	10/15/2025	12:30	137?	*White Ss? (Dakota Ss?)*	**40.4**	G	17.5	21.8	**30.2**		4.54	1.09
20250110878	*160-60097-5*	38.11	-102.80	10/15/2025	15:20	32	*Unk (Quaternary?)*	**128**	G	35.4	33.9	**98.1**		12.4	1.08
20251010880	*160-60199-1*	38.10	-104.43	10/15/2025	12:00	Unk	*Unk*	**74.1**	G	48.6	67.6	**22.2**		4.43	1.89
20250610882	*160-60199-3*	38.53	-102.60	10/15/2025	8:30	51	*Sand and Sh (Quaternary and Smoky Hill Sh)*	**48.9**	G	19.4	20.4	**19.3**		3.26	1.04
20250990883	*160-60199-4*	38.24	-102.53	10/21/2025	15:00	124	*Clay, limestone and Sh (Fort Hays Limestone)*	**42.7**	G	20.8	25.7	**34.8**		5.26	1.47
20250250884	*160-60199-5*	38.18	-103.89	10/18/2025	13:20	34	*Unk (Quaternary?)*	**127**	G	50.4	55.6	**66.4**		8.75	1.17
20250250891	*160-60465-1*	38.40	-103.72	11/19/2025	13:25	22	*Unk (Quaternary?)*	**52.5**	G	29.0	40.1	**39.0**		5.40	0.953

NOTES:

[1] DWG are drinking water guidelines. Results greater than these guidelines are bolded.

[2] Geology is based on well driller's log where available, well owner reported information, report OF-19-11 subcrop map and interpretations based on surface geology and wells lithology. Ss = Sandstone. Sh = Shale. Interpreted formations and depth uncertainties are marked with ?

[3] Radionuclide total uncertainty value (2 sigma) shown as 2σ(±).

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Radionuclide data values preceded by minus sign "-" are equivalent to ND.

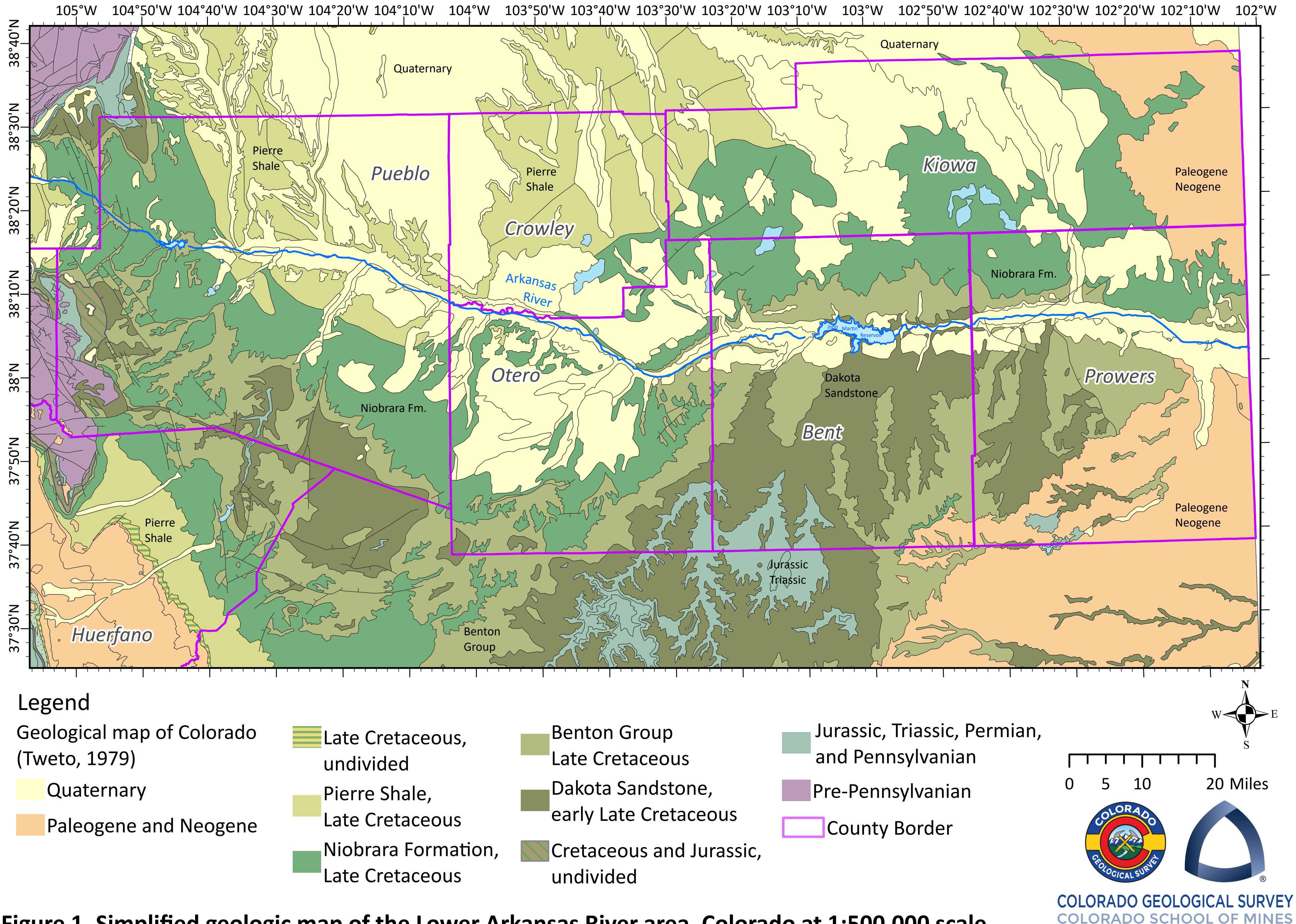

Figure 1. Simplified geologic map of the Lower Arkansas River area, Colorado at 1:500,000 scale (modified from Tweto, 1979). Near surface bedrock units consist of predominantly younger Cretaceous formations on the northern side of the valley compared to the south.

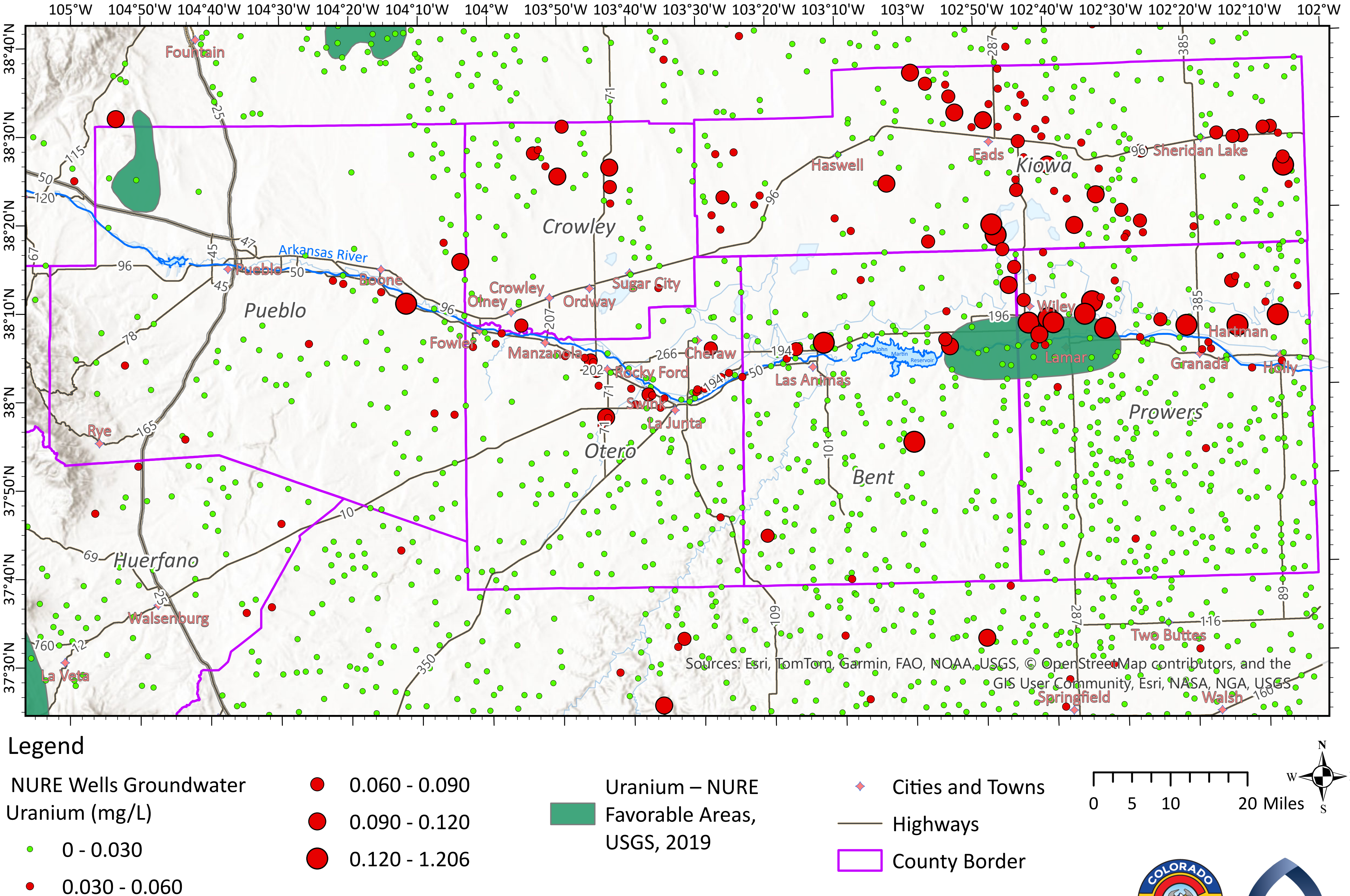

Figure 2. National Uranium Resource Evaluation (NURE) groundwater data in the Lower Arkansas River area, Colorado. Exceedances of the 0.030 mg/L drinking water guideline for uranium are shown in red. Elevated concentrations increase along the Arkansas River Valley, downstream of Pueblo and to the east. Uranium levels are frequently higher on the northern side of the valley compared to the southern side.

COLORADO GEOLOGICAL SURVEY
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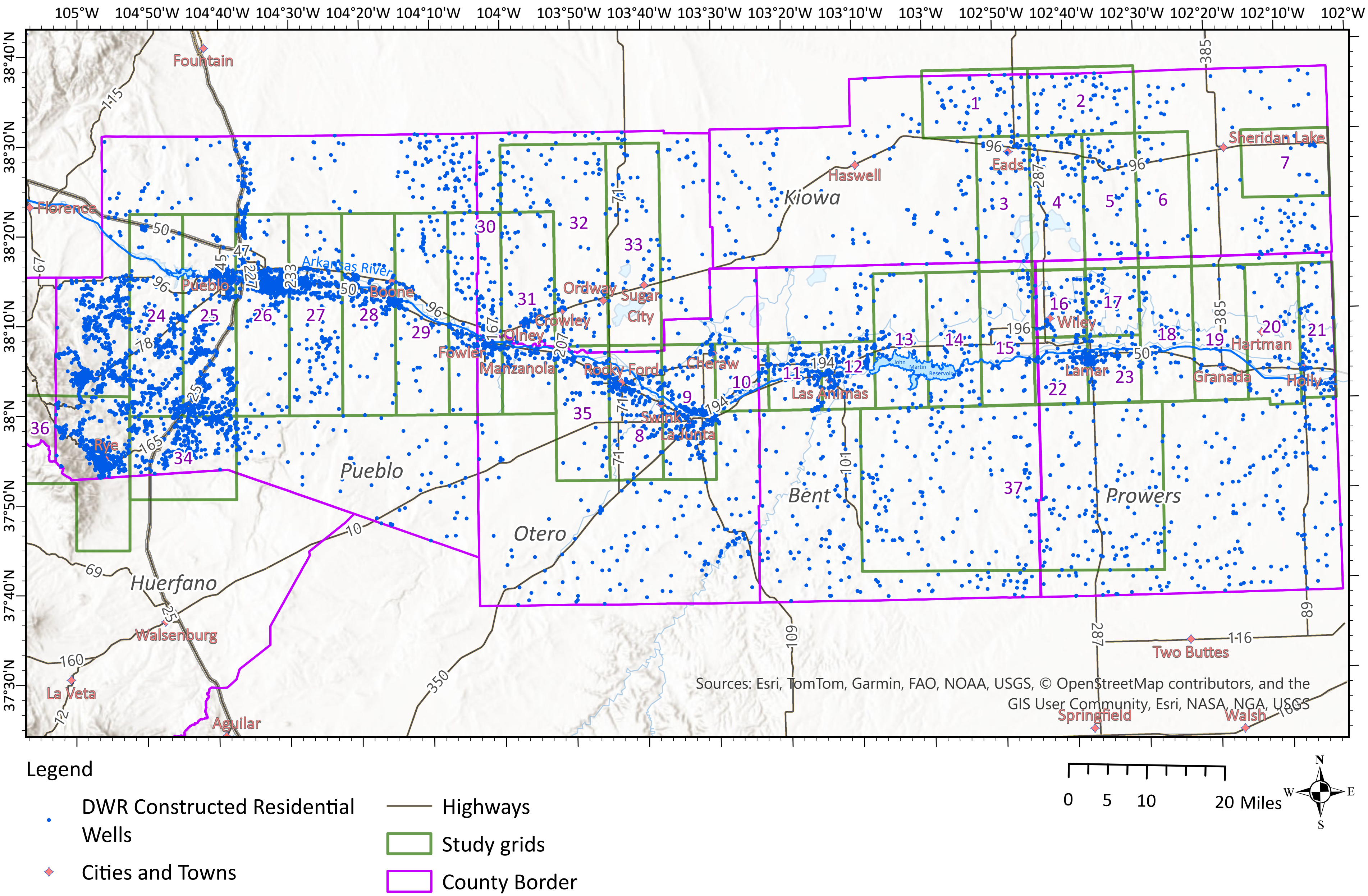

Figure 3. Constructed residential wells from the Colorado Division of Water Resources (DWR) and the 37 Study Grids. The grid was designed to obtain representative coverage with a focus on areas with elevated uranium levels, and refined using the constructed residential wells data.

COLORADO GEOLOGICAL SURVEY
COLORADO SCHOOL OF MINES

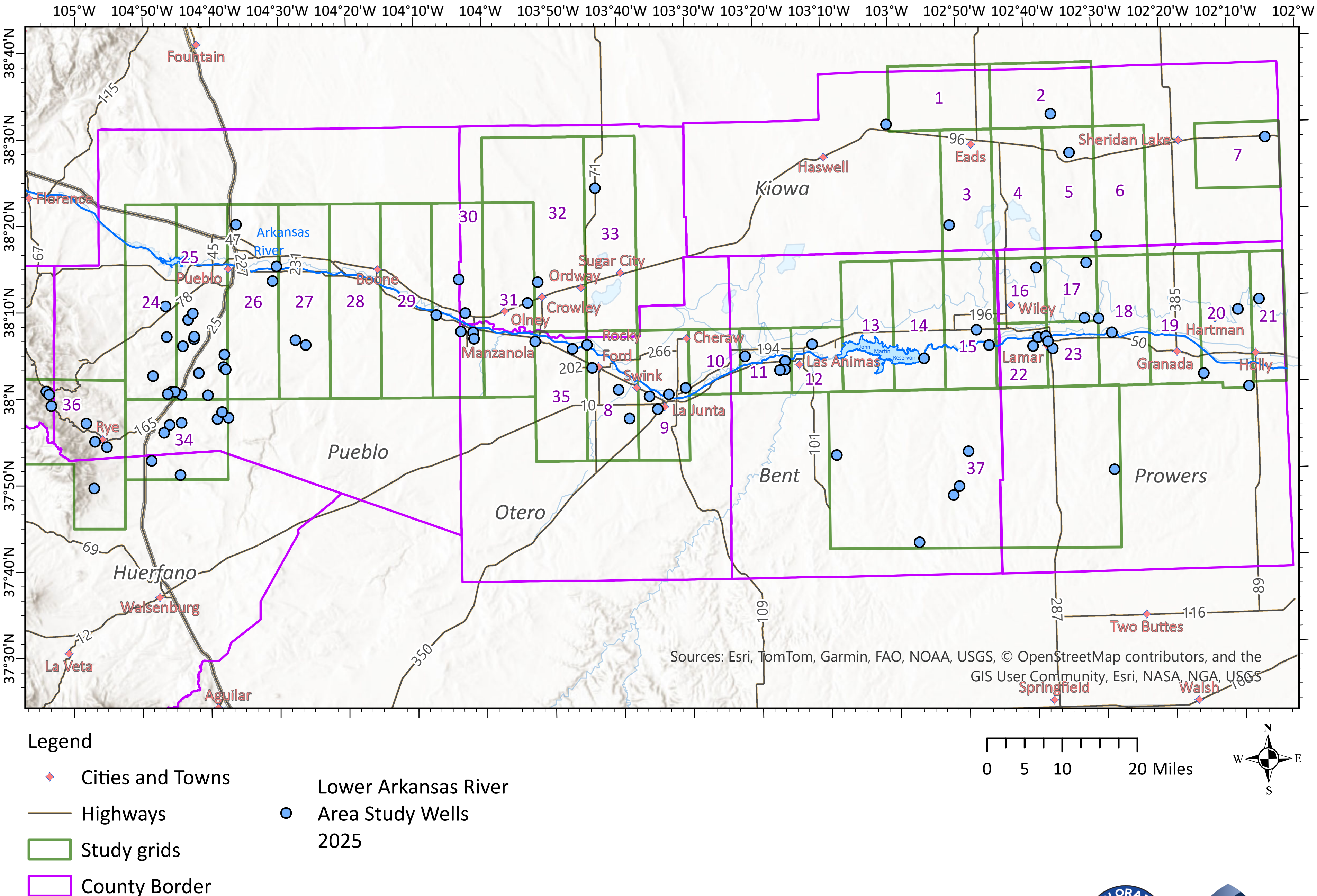

Figure 4. Residential water wells sampled in 2025 in the Lower Arkansas River area, Colorado. Although the overall volunteer participation was generally good, with 91 sampled wells, several grids remained unsampled, while other areas showed localized clustering of sampled wells.

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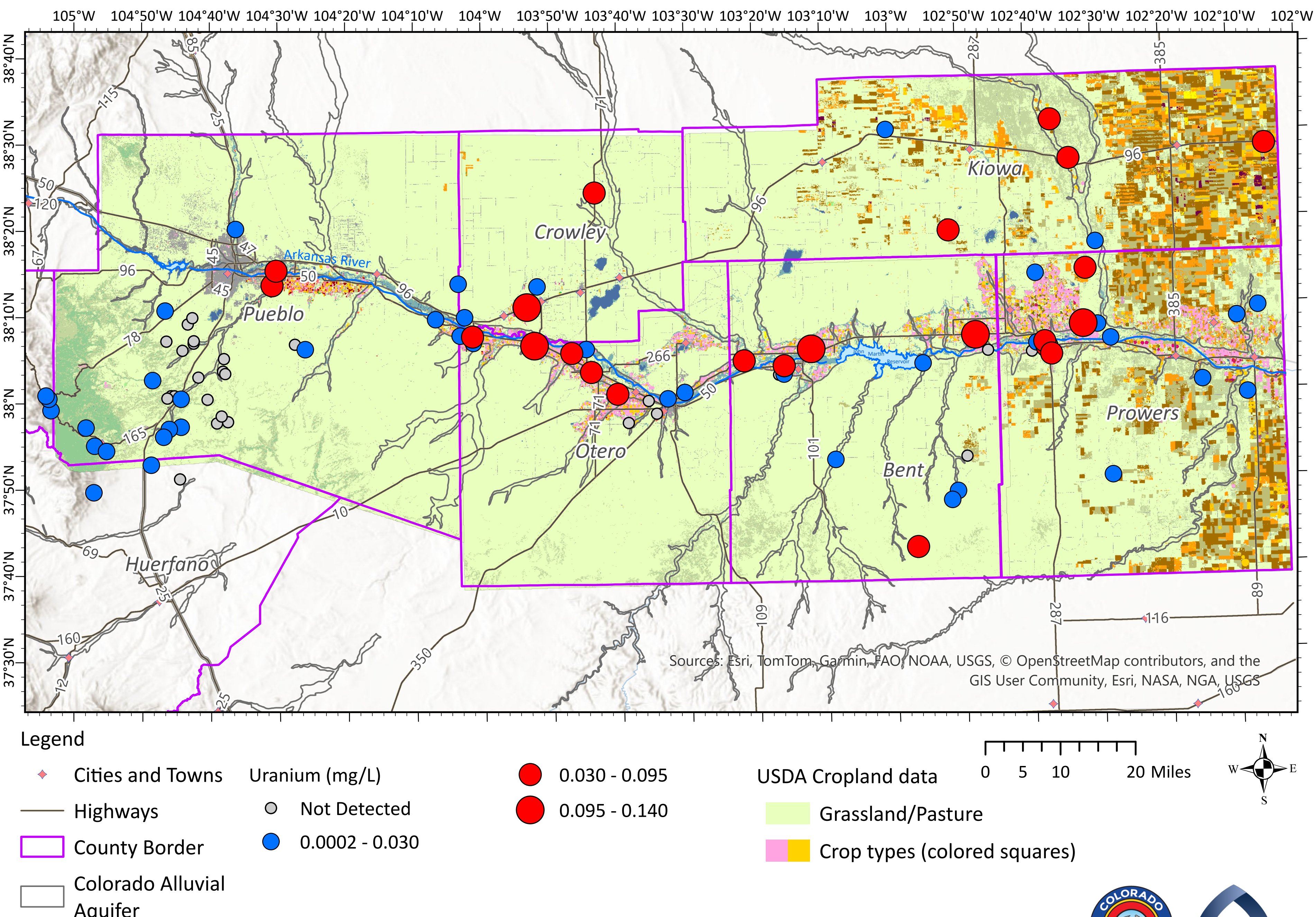

Figure 5. Uranium concentrations in milligrams per liter (mg/L) from water wells in the Lower Arkansas River area, Colorado. Wells with concentrations exceeding the drinking water guideline of 0.03 mg/L are shown in red. Background: U.S. Department of Agriculture (USDA) Cropland Data Layer (CDL), retrieved September 18, 2025, from https://croplandcros.scinet.usda.gov/.

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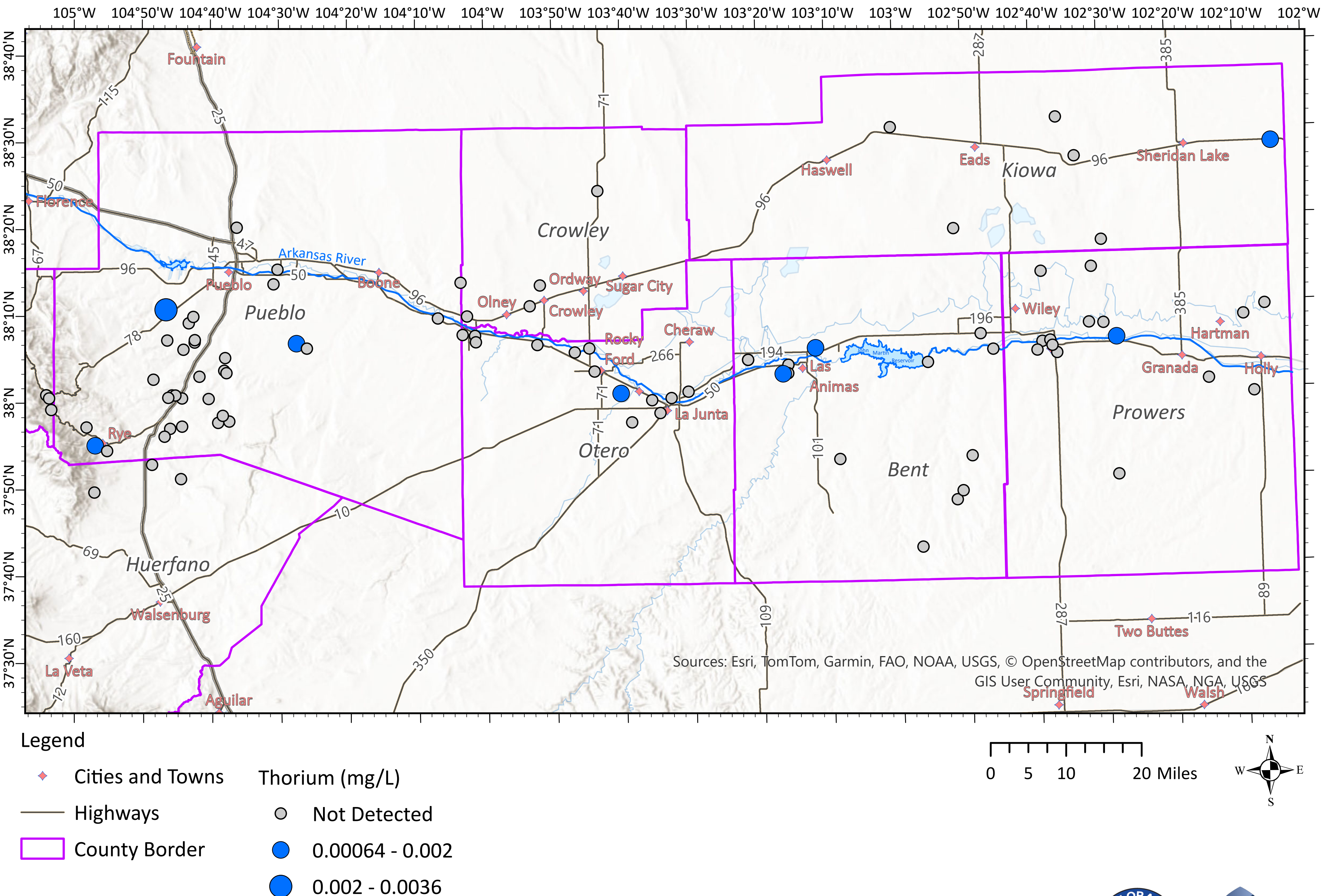

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Figure 6. Thorium concentrations in milligrams per liter (mg/L) from water wells in the Lower Arkansas River area, Colorado. Thorium does not have a drinking water guideline but contributes to overall gross radionuclide measurements.

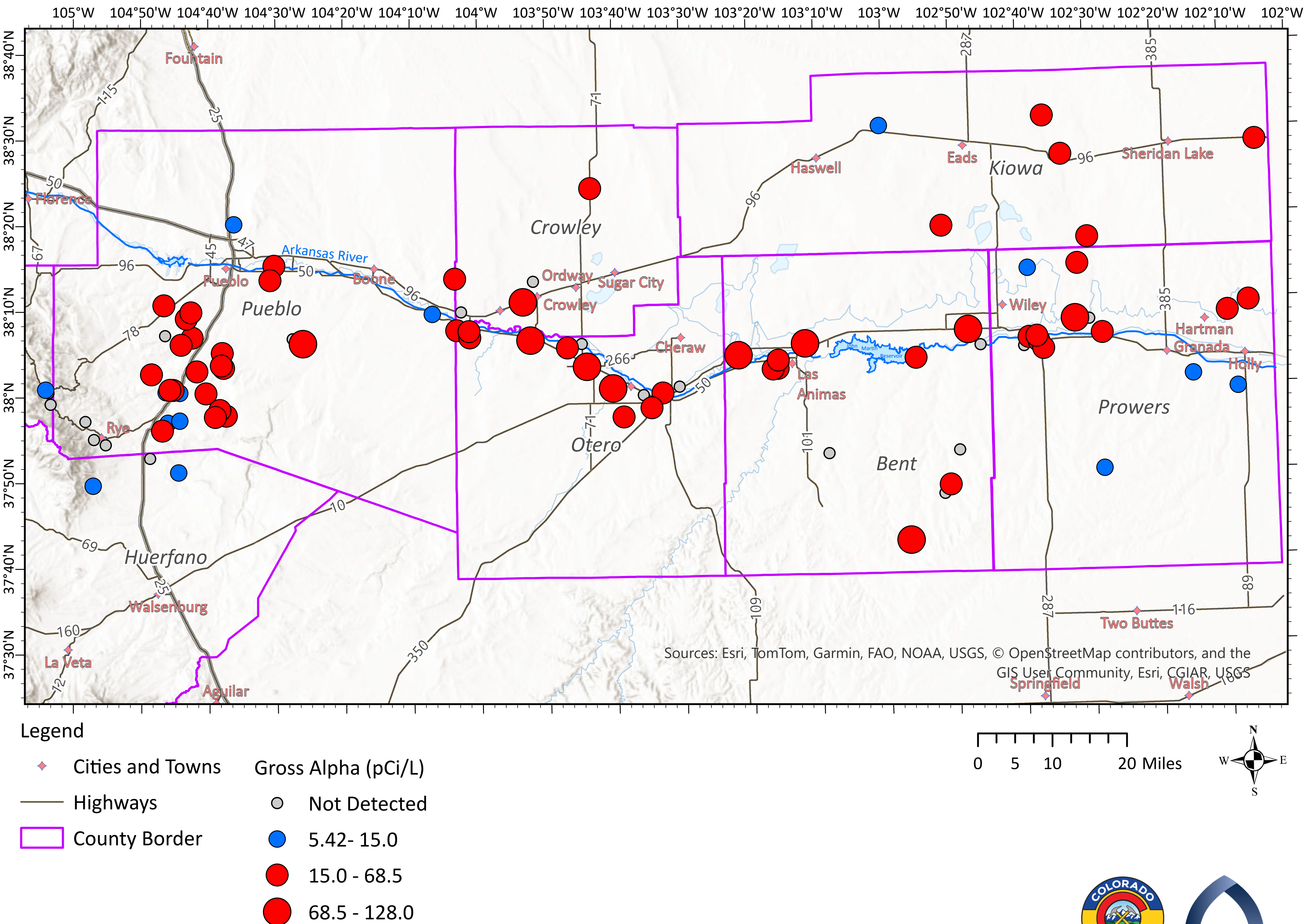

Figure 7. Gross Alpha concentrations in picocuries per liter (pCi/L) from water wells in the Lower Arkansas River area, Colorado. Wells with concentrations exceeding the drinking water guideline of 15 pCi/L are shown in red.

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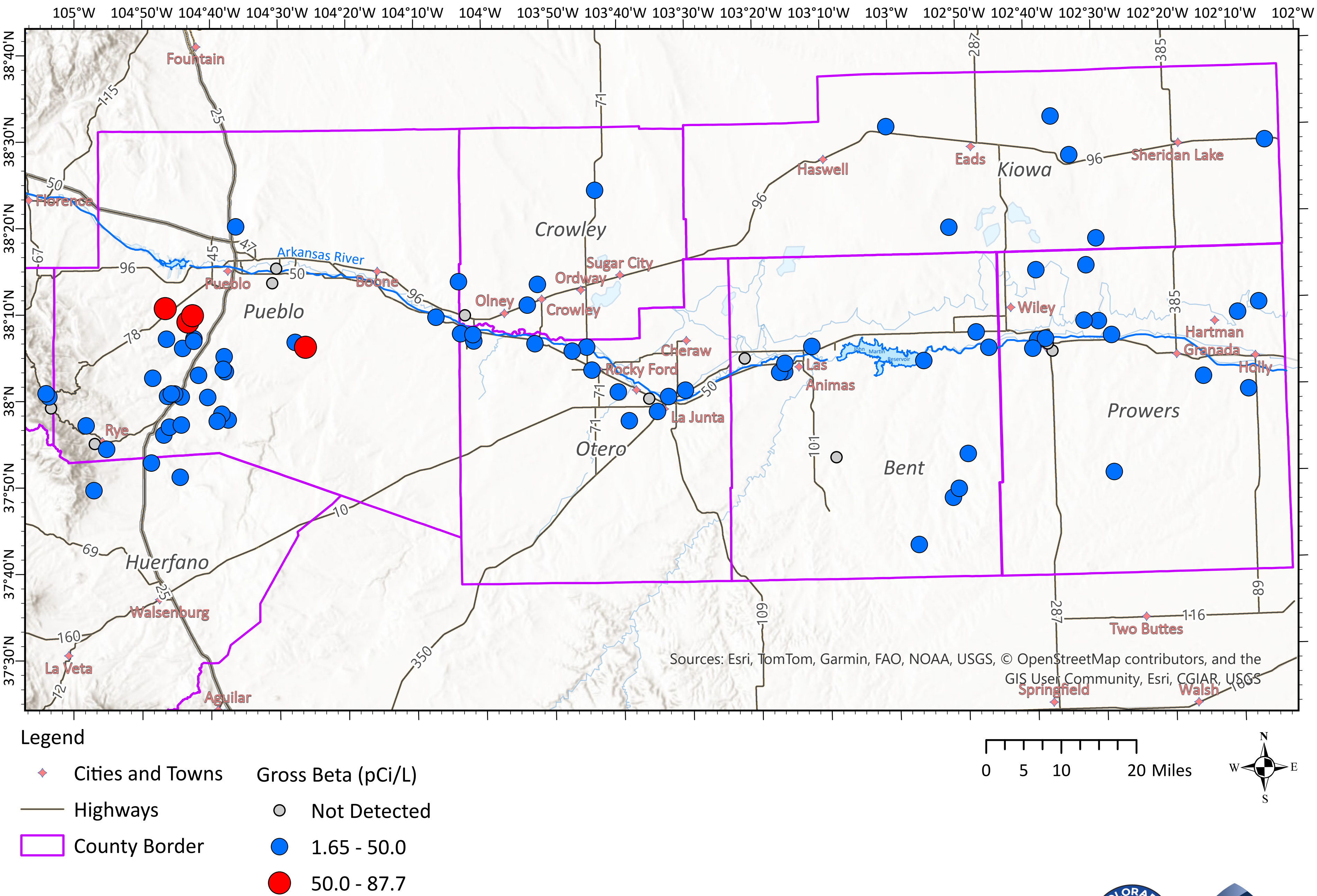

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Figure 8. Gross Beta concentrations in picocuries per liter (pCi/L) from water wells in the Lower Arkansas River area, Colorado. Wells with concentrations exceeding the drinking water guideline of 50 pCi/L are shown in red.

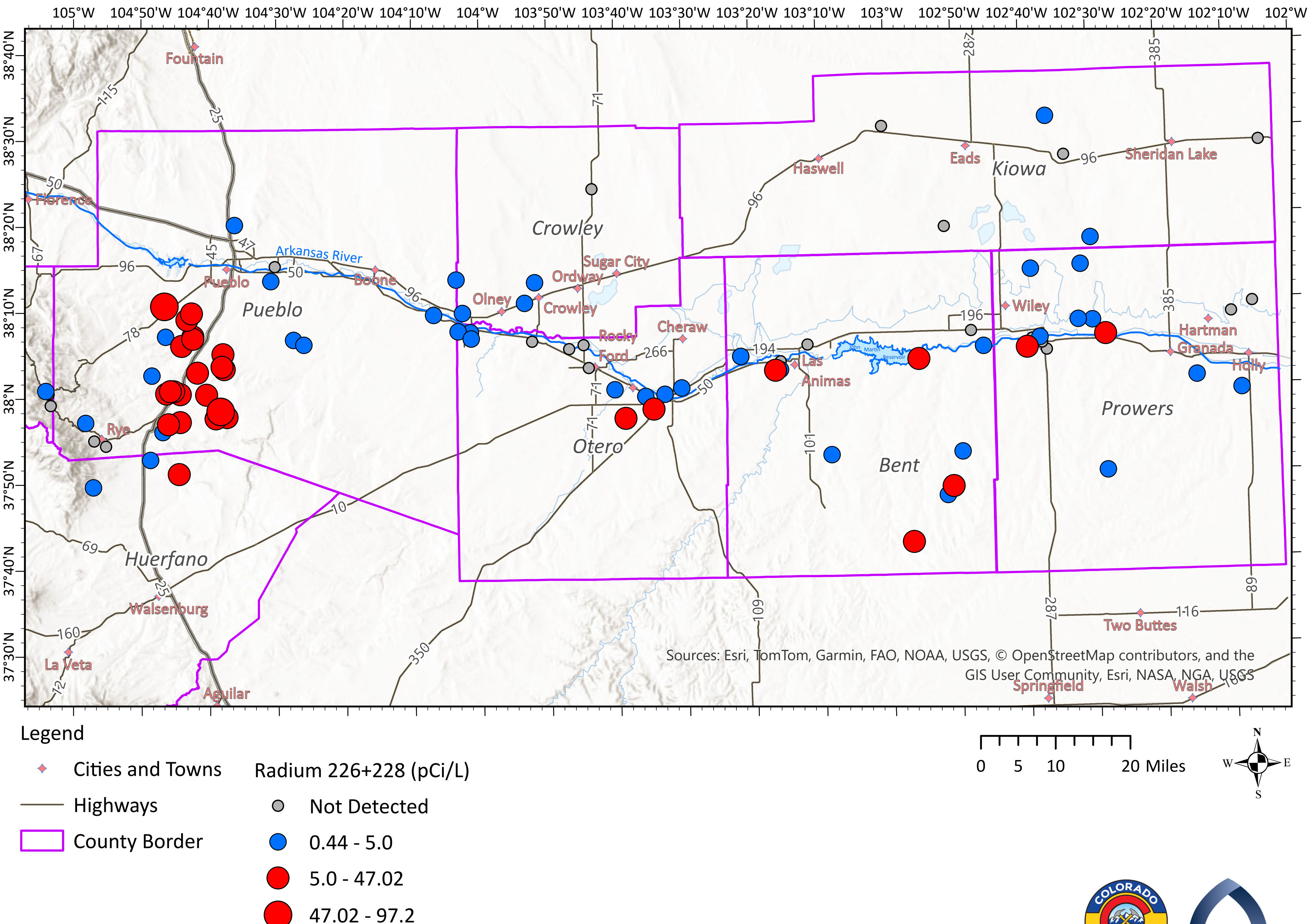

Figure 9. Radium-226+228 concentrations in picocuries per liter (pCi/L) from water wells in the Lower Arkansas River area, Colorado. Wells with concentrations exceeding the drinking water guideline of 5 pCi/L are shown in red.

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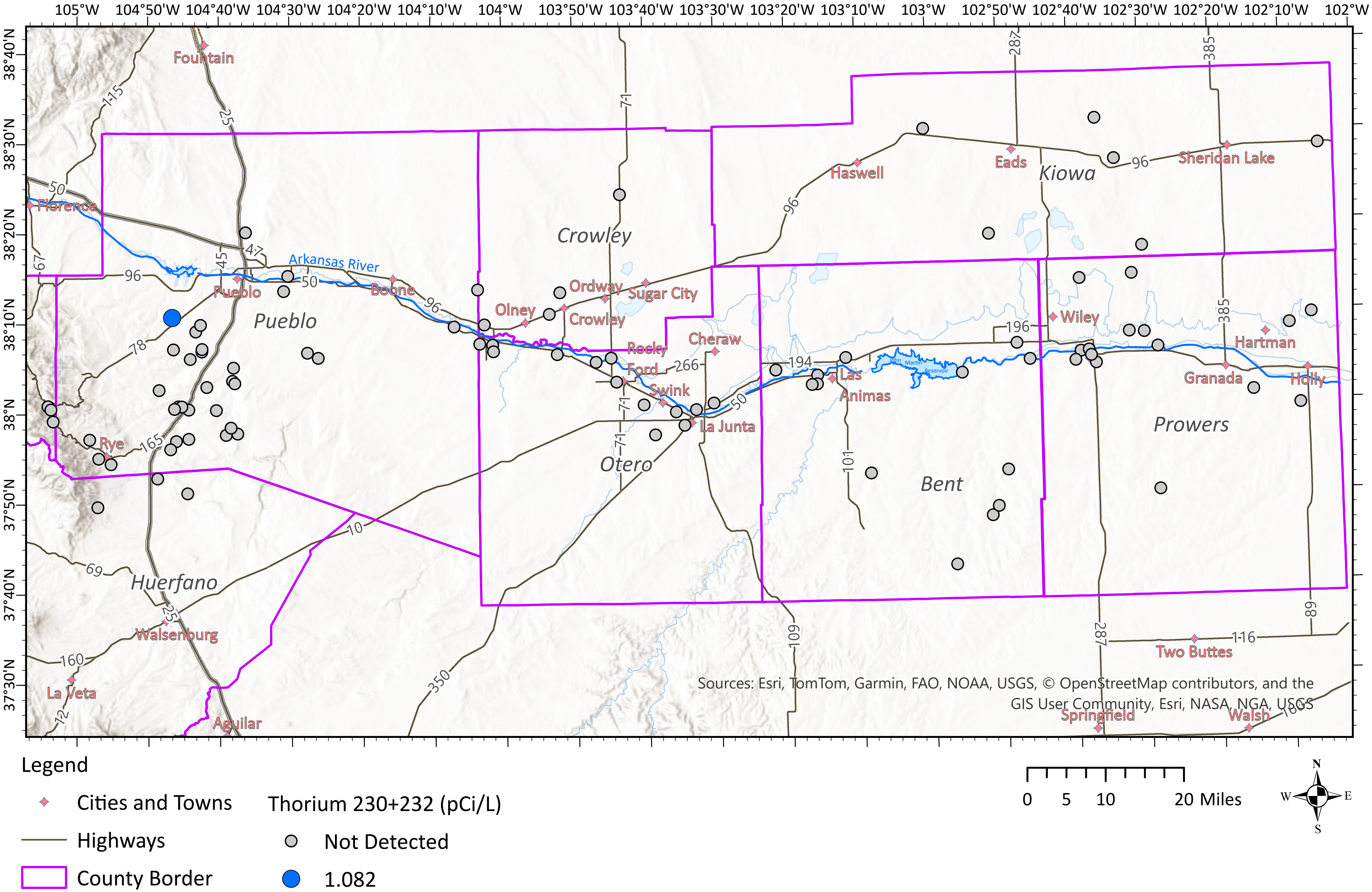

Figure 10. Thorium-230+232 concentrations in picocuries per liter (pCi/L) from water wells in the Lower Arkansas River area, Colorado. There are no wells with concentrations exceeding the drinking water guideline of 60 pCi/L, but Thorium-230+232 does contribute to overall gross radionuclide measurements.

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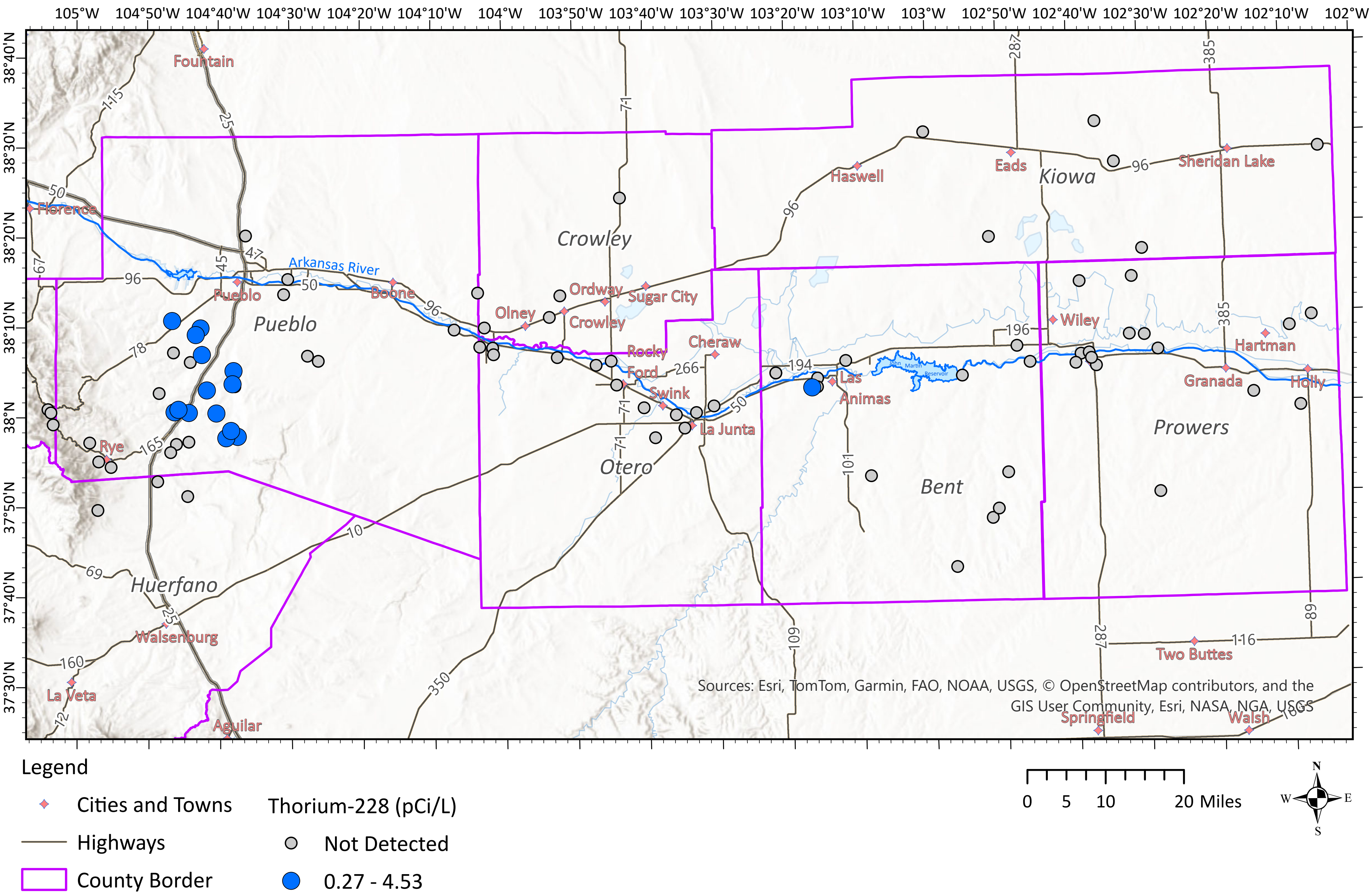

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Figure 11. Thorium-228 concentrations in picocuries per liter (pCi/L) from water wells in the Lower Arkansas River area, Colorado. Thorium-228 does not have a drinking water guideline but contributes to overall gross radionuclide measurements.

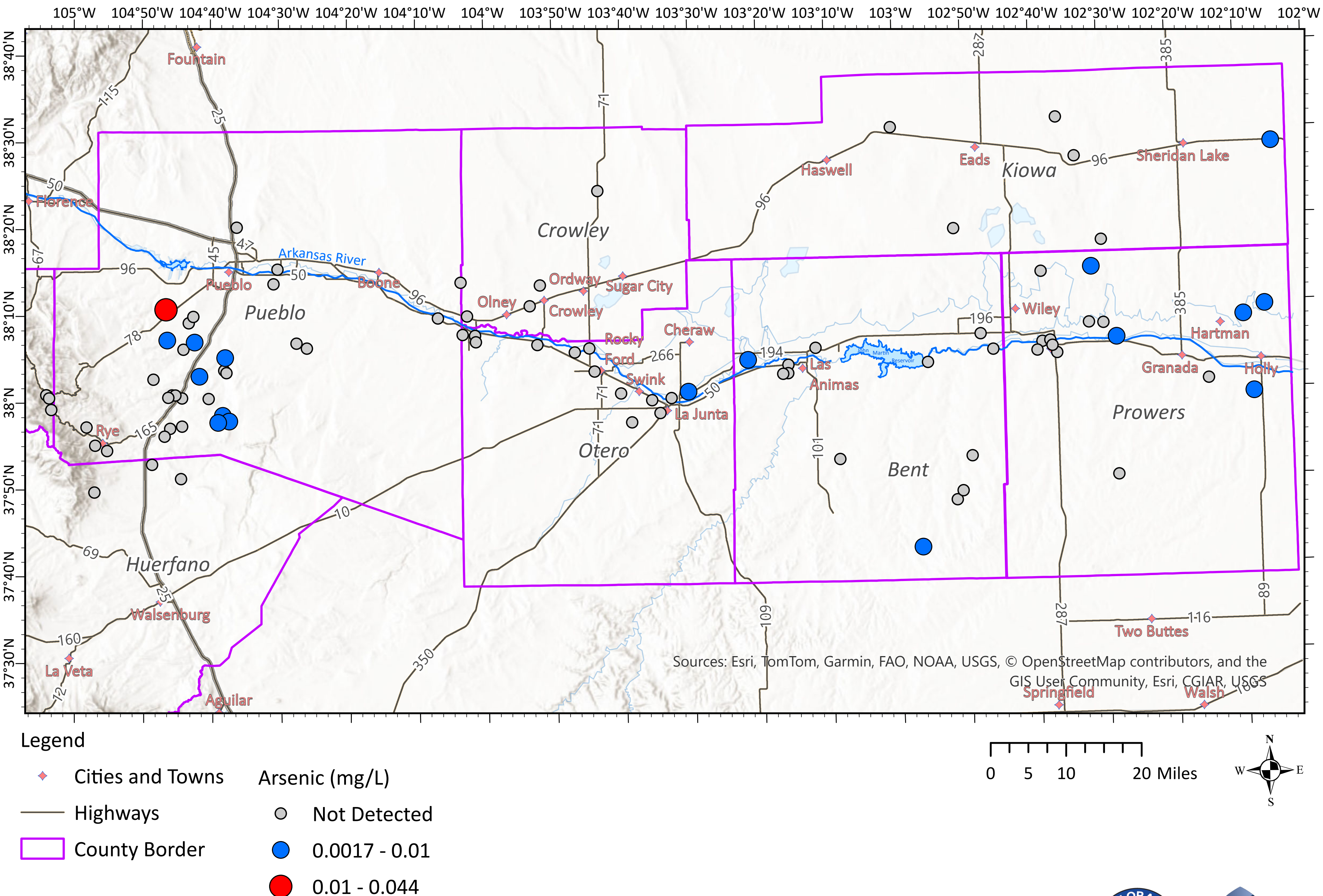

Figure 12. Arsenic concentrations in milligrams per liter (mg/L) from water wells in the Lower Arkansas River area, Colorado. Wells with concentrations exceeding the drinking water guideline of 0.01 mg/L are shown in red.

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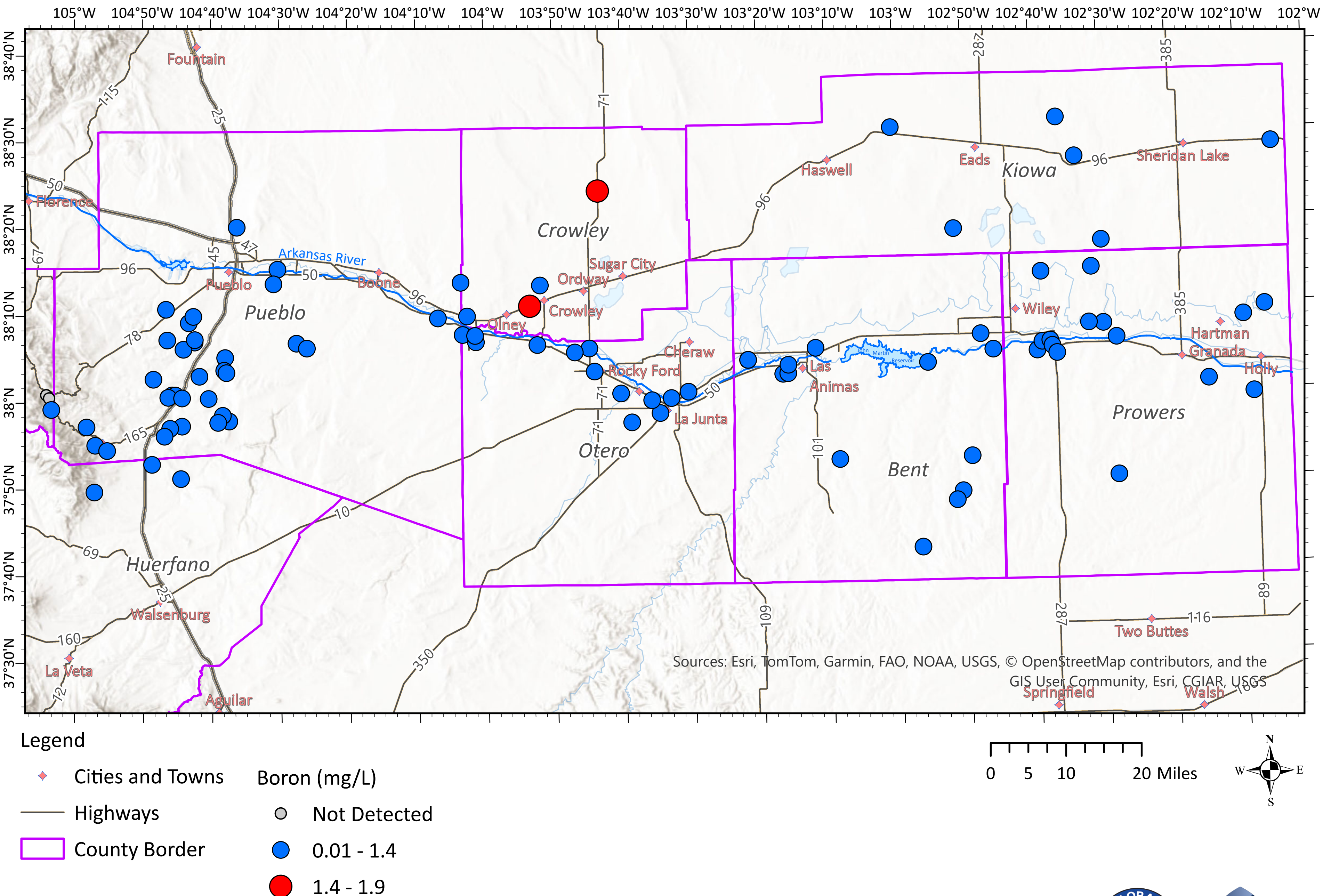

Figure 13. Boron concentrations in milligrams per liter (mg/L) from water wells in the Lower Arkansas River area, Colorado. Wells with concentrations exceeding the drinking water guideline of 1.4 mg/L are shown in red.

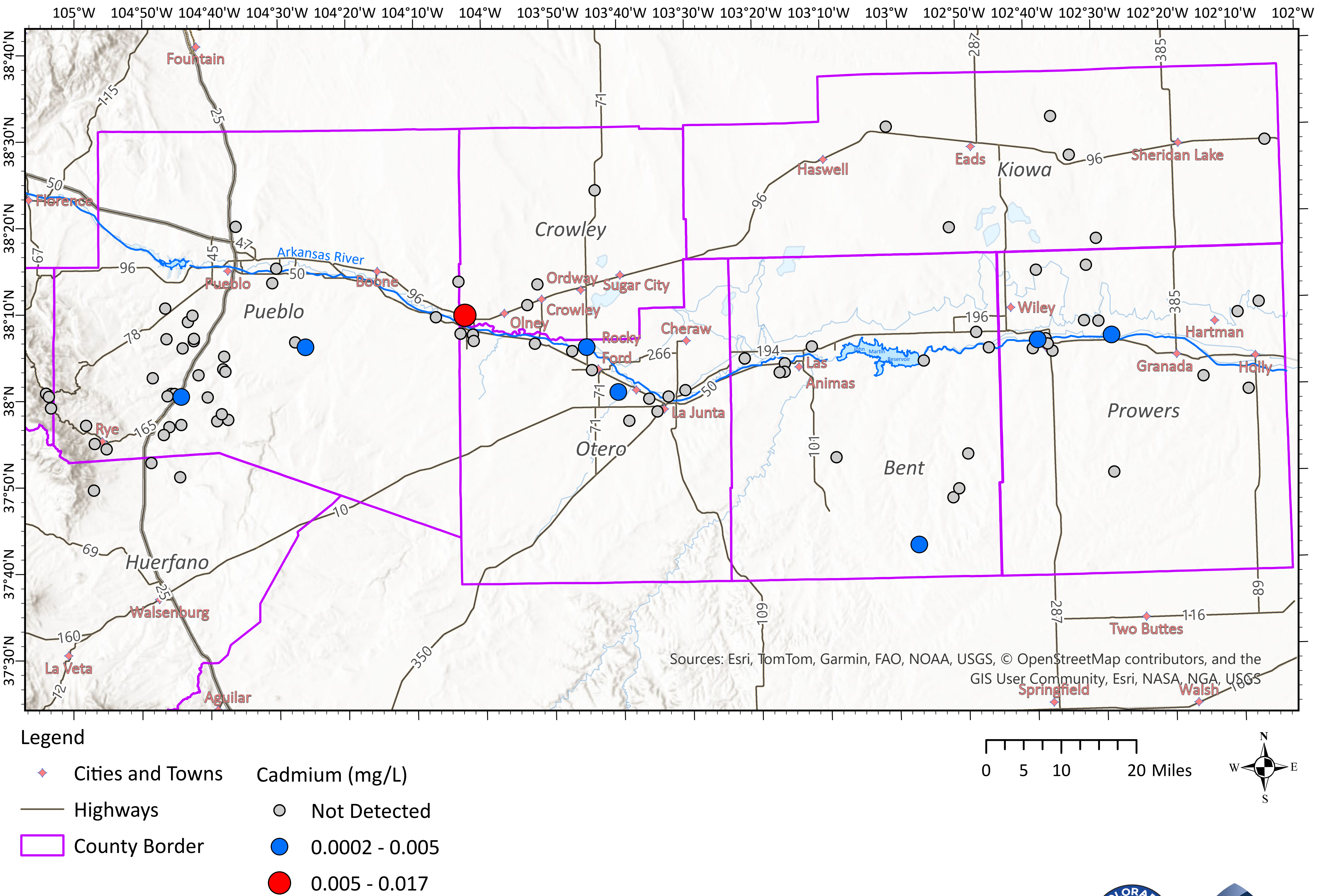

Figure 14. Cadmium concentrations in milligrams per liter (mg/L) from water wells in the Lower Arkansas River area, Colorado. Wells with concentrations exceeding the drinking water guideline of 0.005 mg/L are shown in red.

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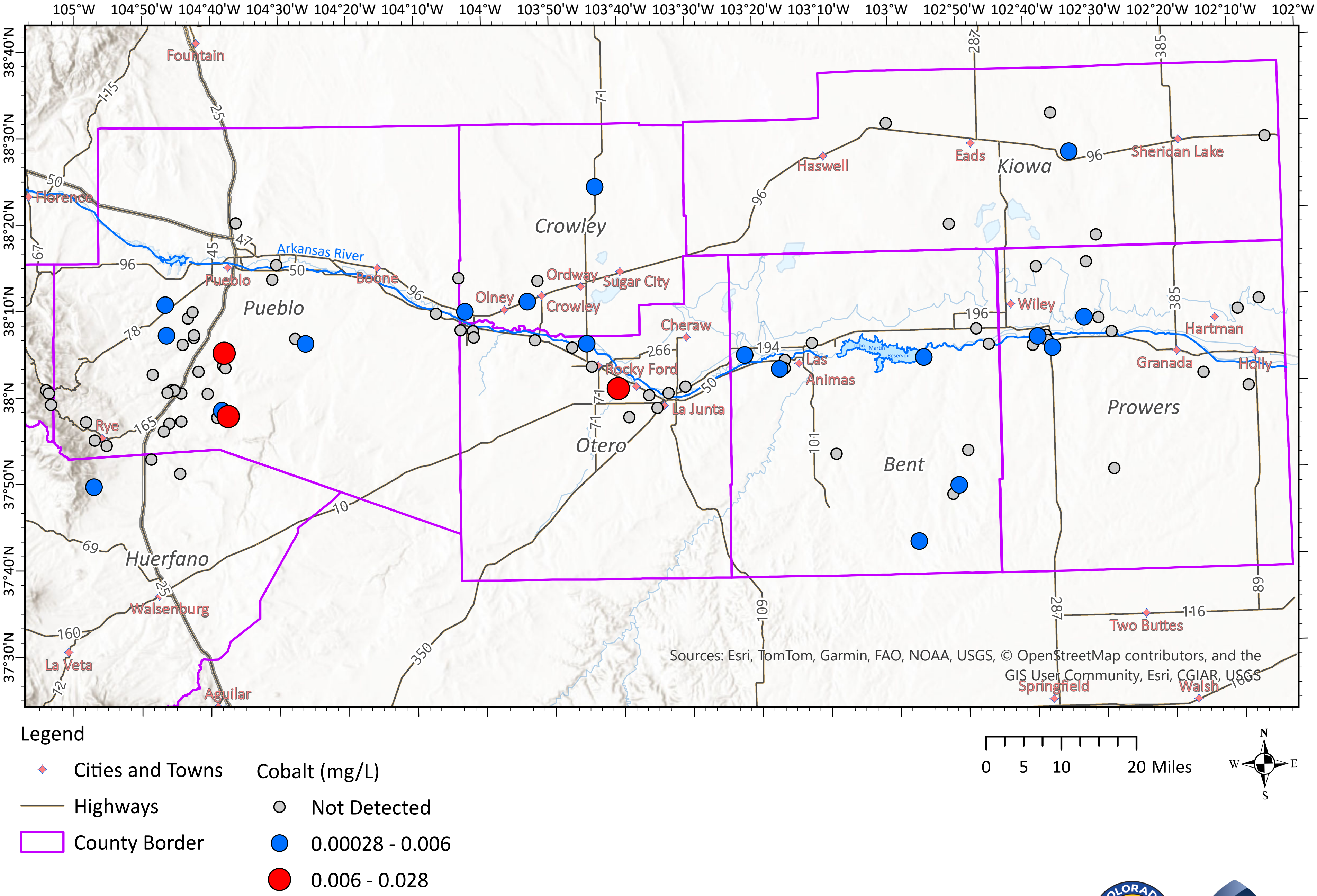

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Figure 15. Cobalt concentrations in milligrams per liter (mg/L) from water wells in the Lower Arkansas River area, Colorado. Wells with concentrations exceeding the drinking water guideline of 0.006 mg/L are shown in red.

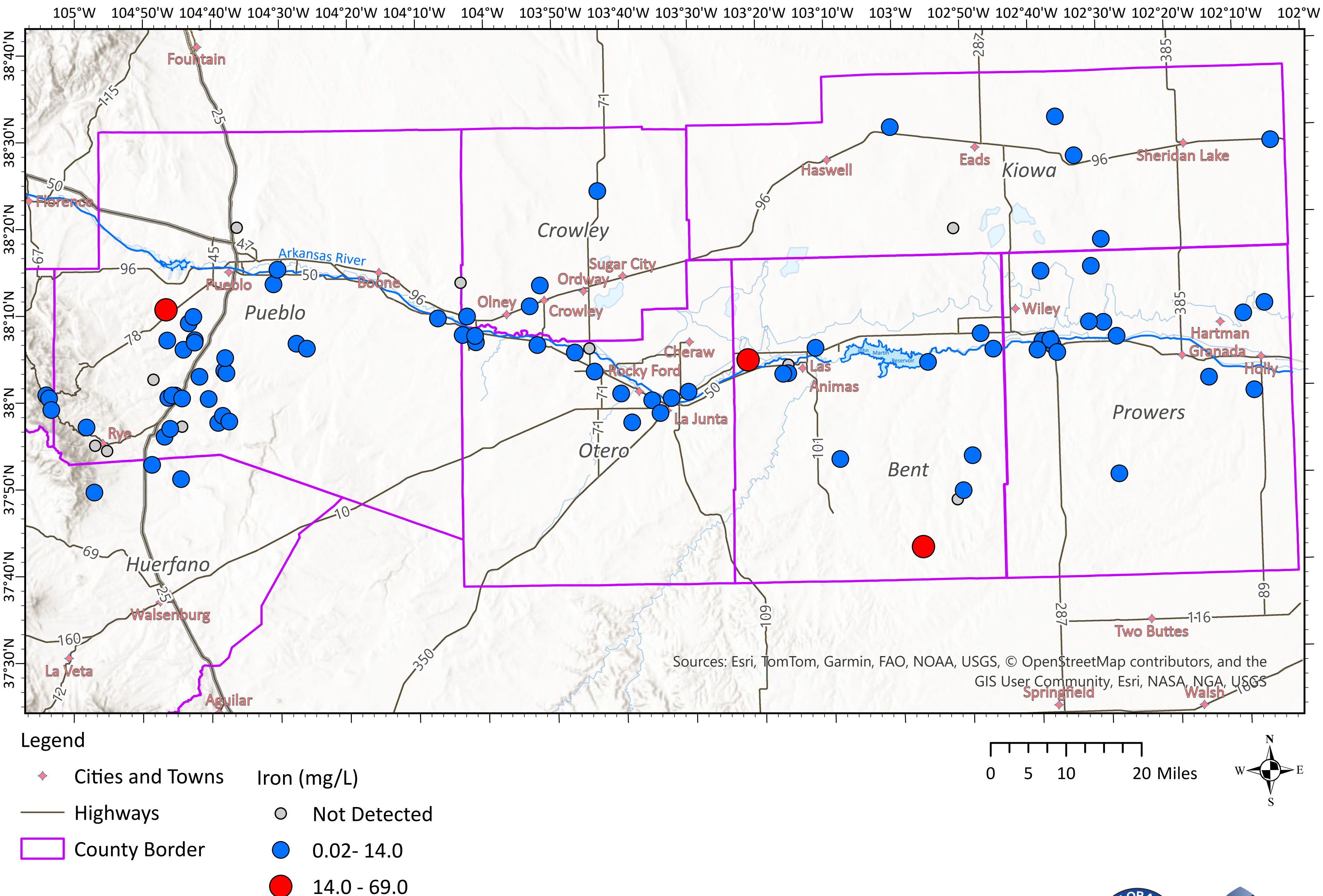

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Figure 16. Iron concentrations in milligrams per liter (mg/L) from water wells in the Lower Arkansas River area, Colorado. Wells with concentrations exceeding the drinking water guideline of 14 mg/L are shown in red.

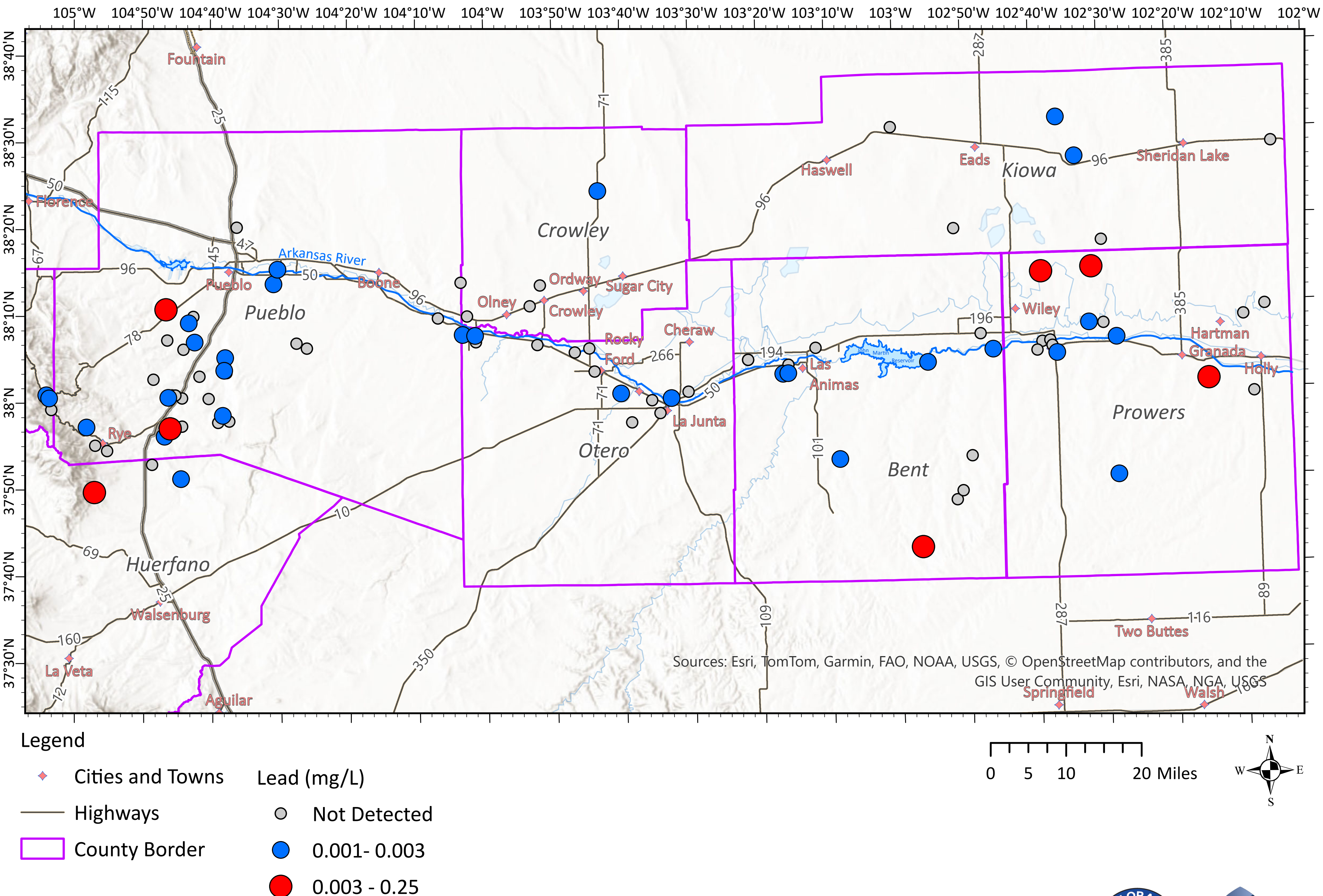

Figure 17. Lead concentrations in milligrams per liter (mg/L) from water wells in the Lower Arkansas River area, Colorado. Locations where values were above the drinking water guideline of being "Present" above the analytical reporting limit (0.003 mg/L) are shown in red. Blue are estimated detections under the reporting limit.

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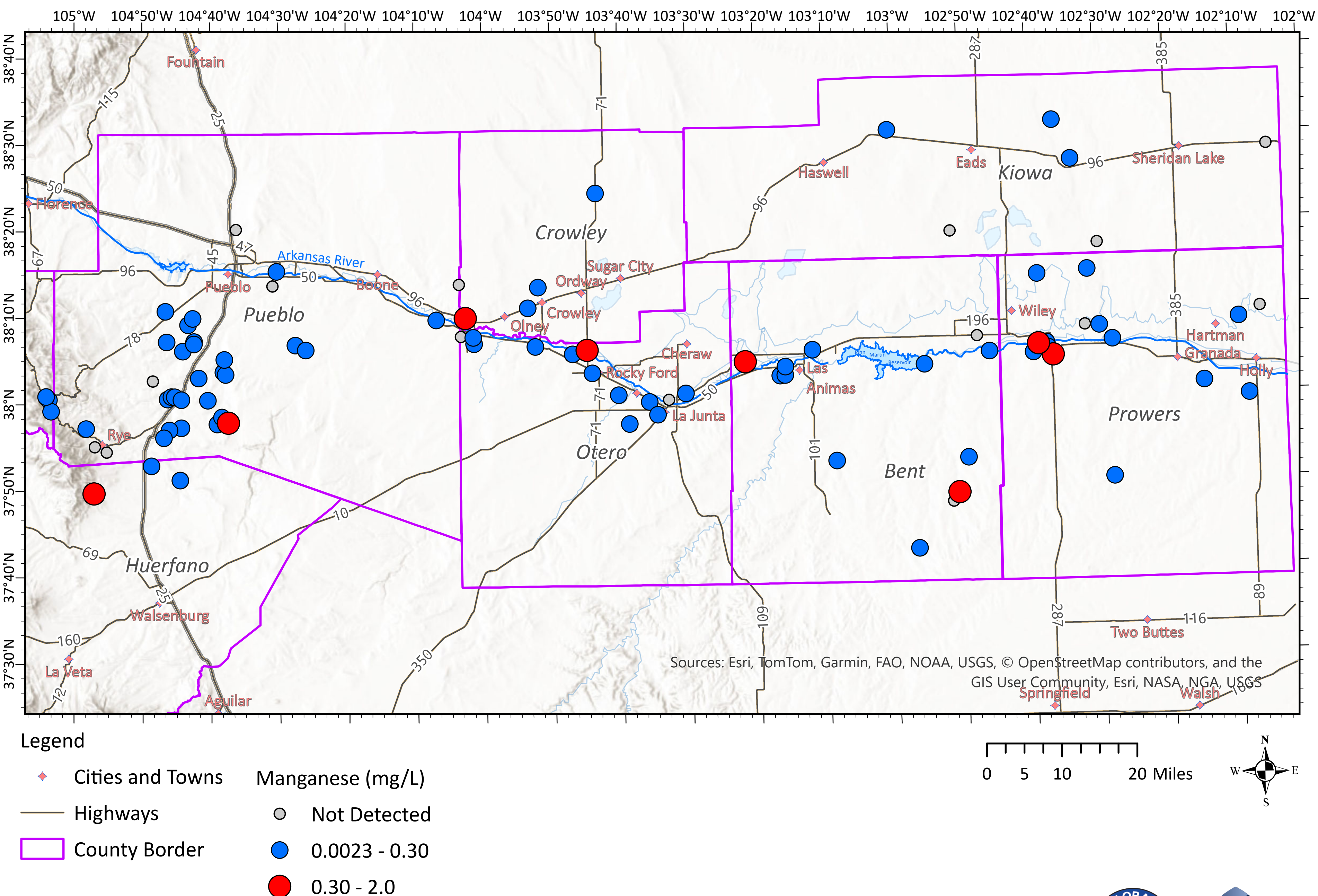

Figure 18. Manganese concentrations in milligrams per liter (mg/L) from water wells in the Lower Arkansas River area, Colorado. Wells with concentrations exceeding the drinking water guideline of 0.3 mg/L are shown in red.

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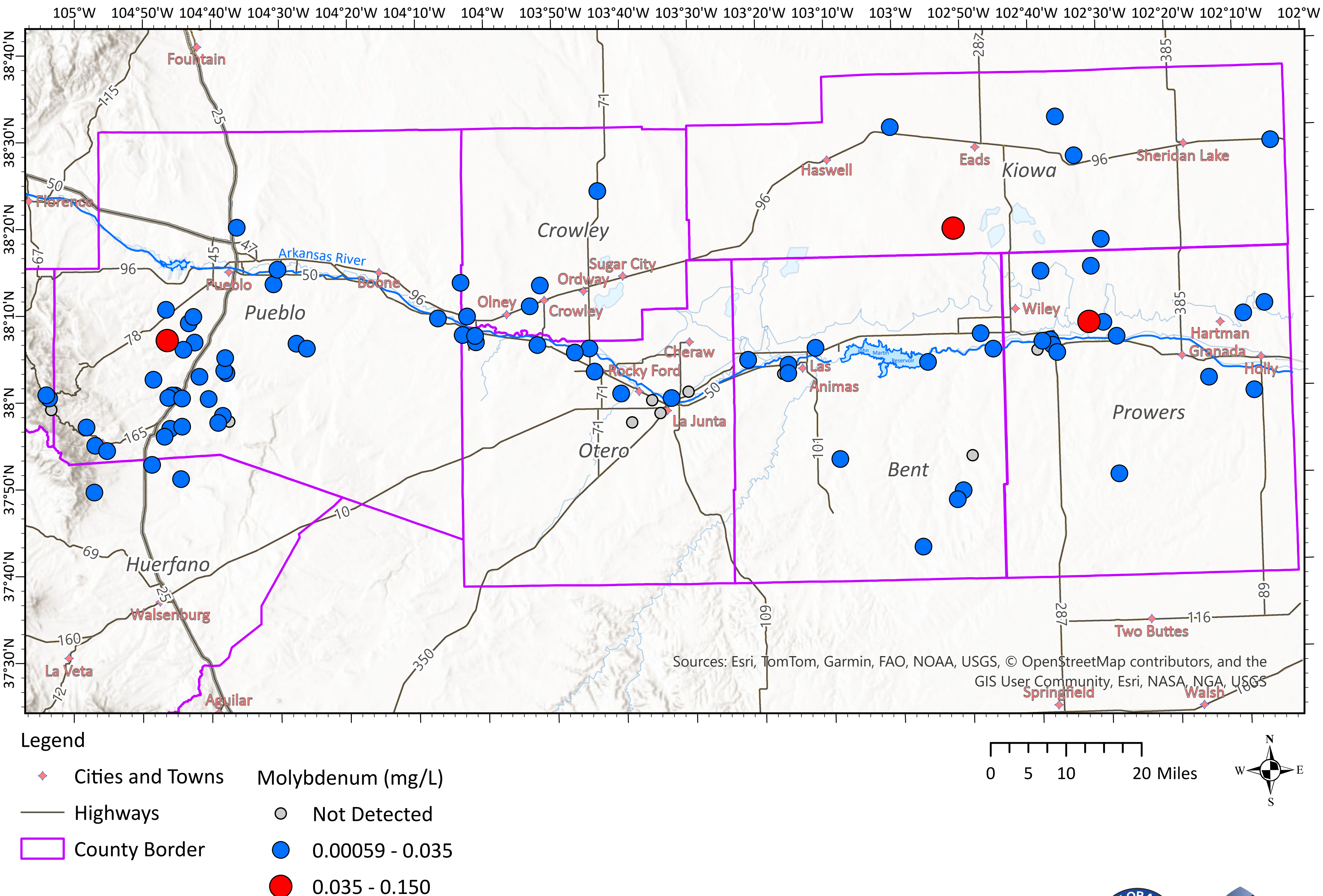

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Figure 19. Molybdenum concentrations in milligrams per liter (mg/L) from water wells in the Lower Arkansas River area, Colorado. Wells with concentrations exceeding the drinking water guideline of 0.035 mg/L are shown in red.

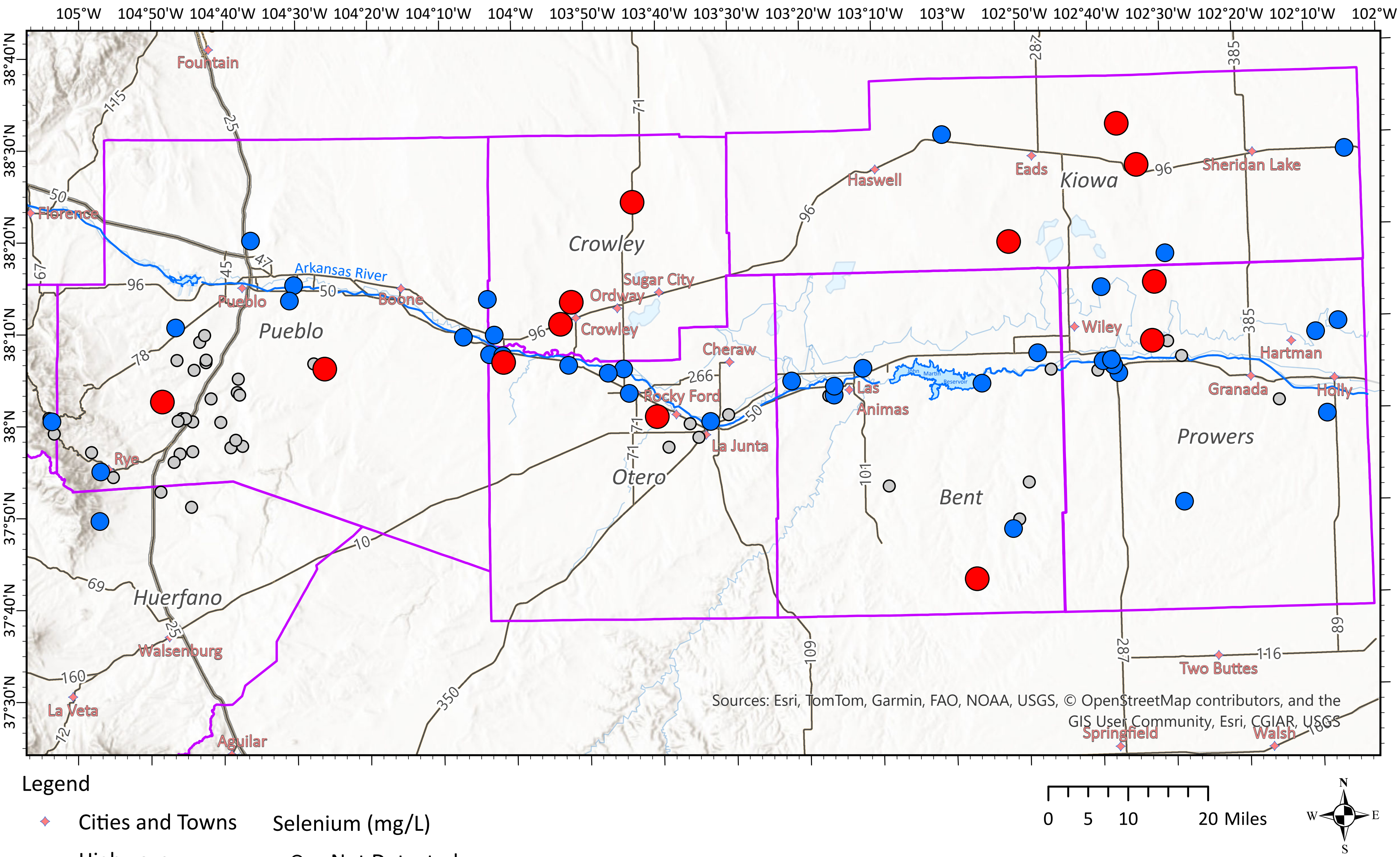

Figure 20. Selenium concentrations in milligrams per liter (mg/L) from water wells in the Lower Arkansas River area, Colorado. Wells with concentrations exceeding the drinking water guideline of 0.05 mg/L are shown in red.

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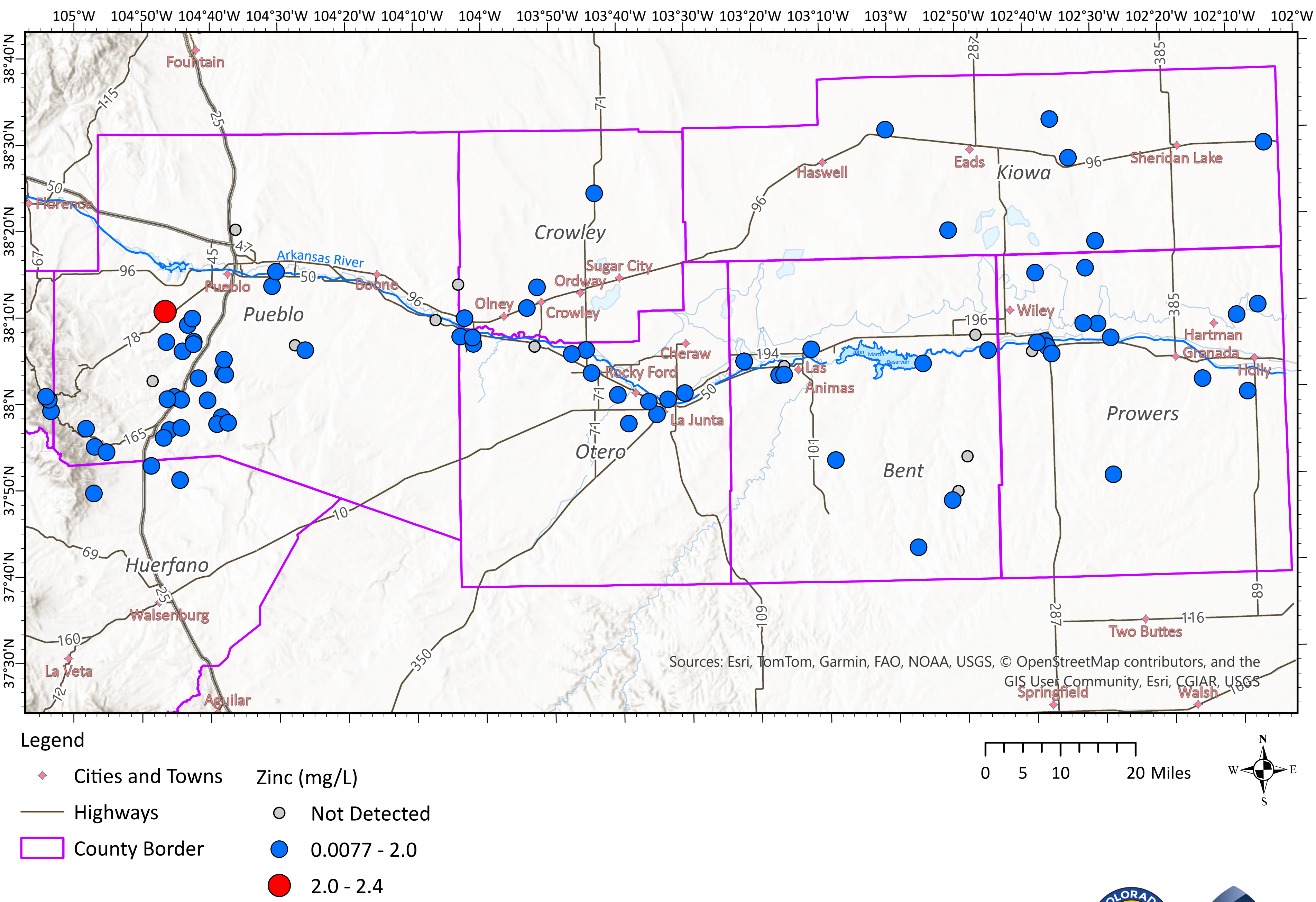

Figure 21. Zinc concentrations in milligrams per liter (mg/L) from water wells in the Lower Arkansas River area, Colorado. Wells with concentrations exceeding the drinking water guideline of 2 mg/L are shown in red.

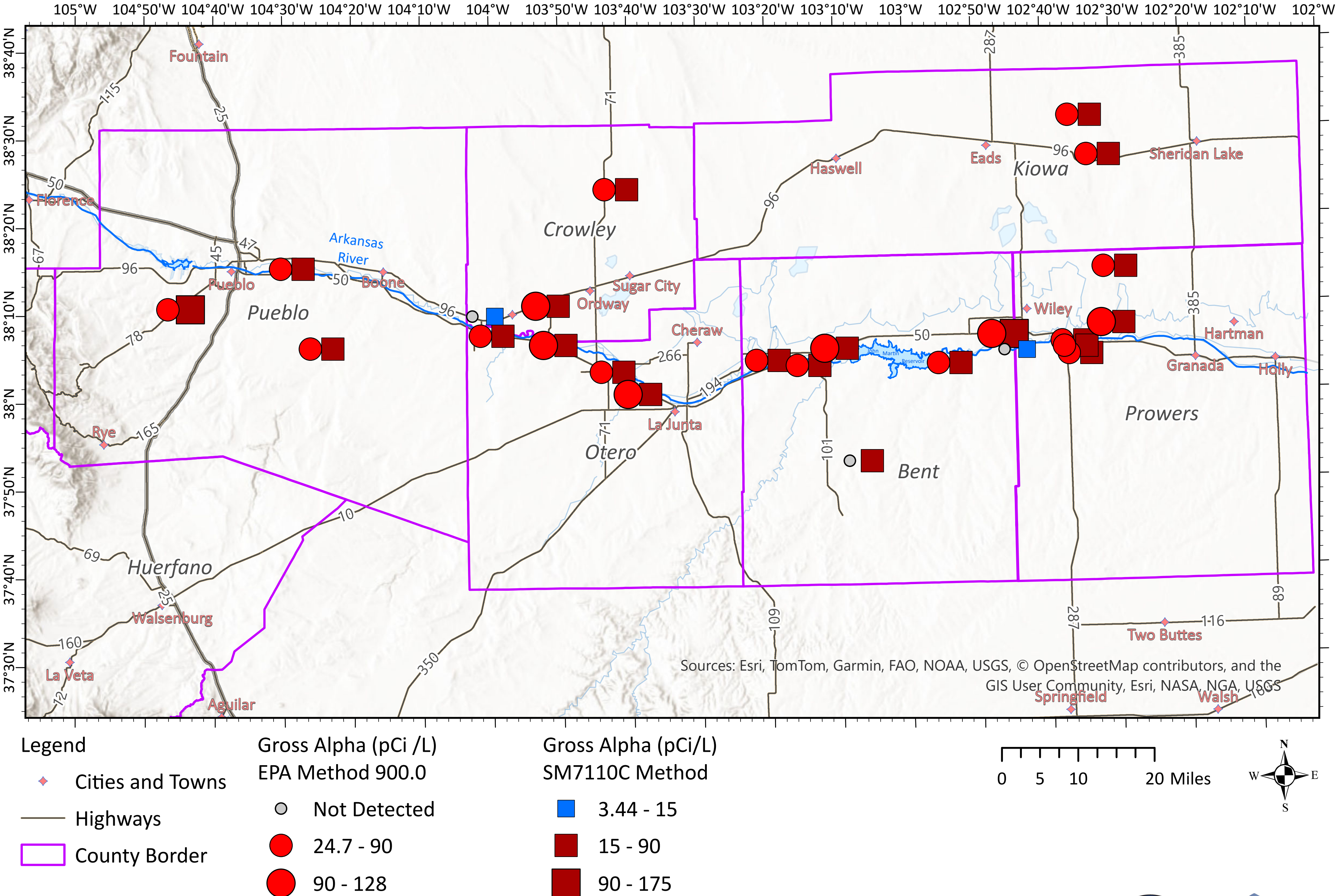

Figure 22. Comparative Gross Alpha concentrations in picocuries per liter (pCi/L) from 24 water wells in the Lower Arkansas River area, Colorado. Results are shown for both the EPA Method 900.0 data and reanalysis of select samples by Standard Method SM7110C. SM7110C data are shifted to the right for better visualization. Wells with concentrations exceeding the drinking water guideline of 15 pCi/L are shown in red and dark red.

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